JUNE 1971

rsc

RAILWAY SYSTEM CONTROLS

Santa Fe closes control loop with ACI

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R R TAYLOR
40 WEST ROAD
LOMBARD ILL 60148

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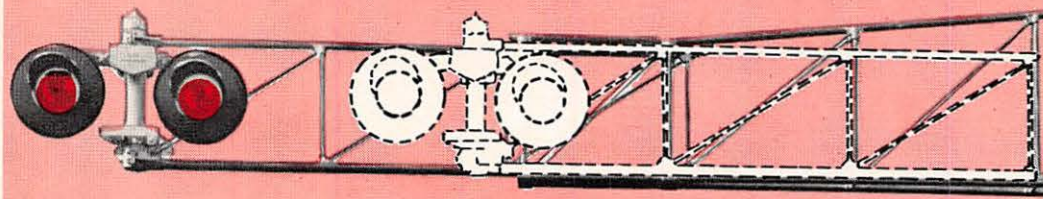
RACO®



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The first rotatable cantilever signal is now the first extendable cantilever signal.

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SIGNAL LIGHT ASSEMBLIES

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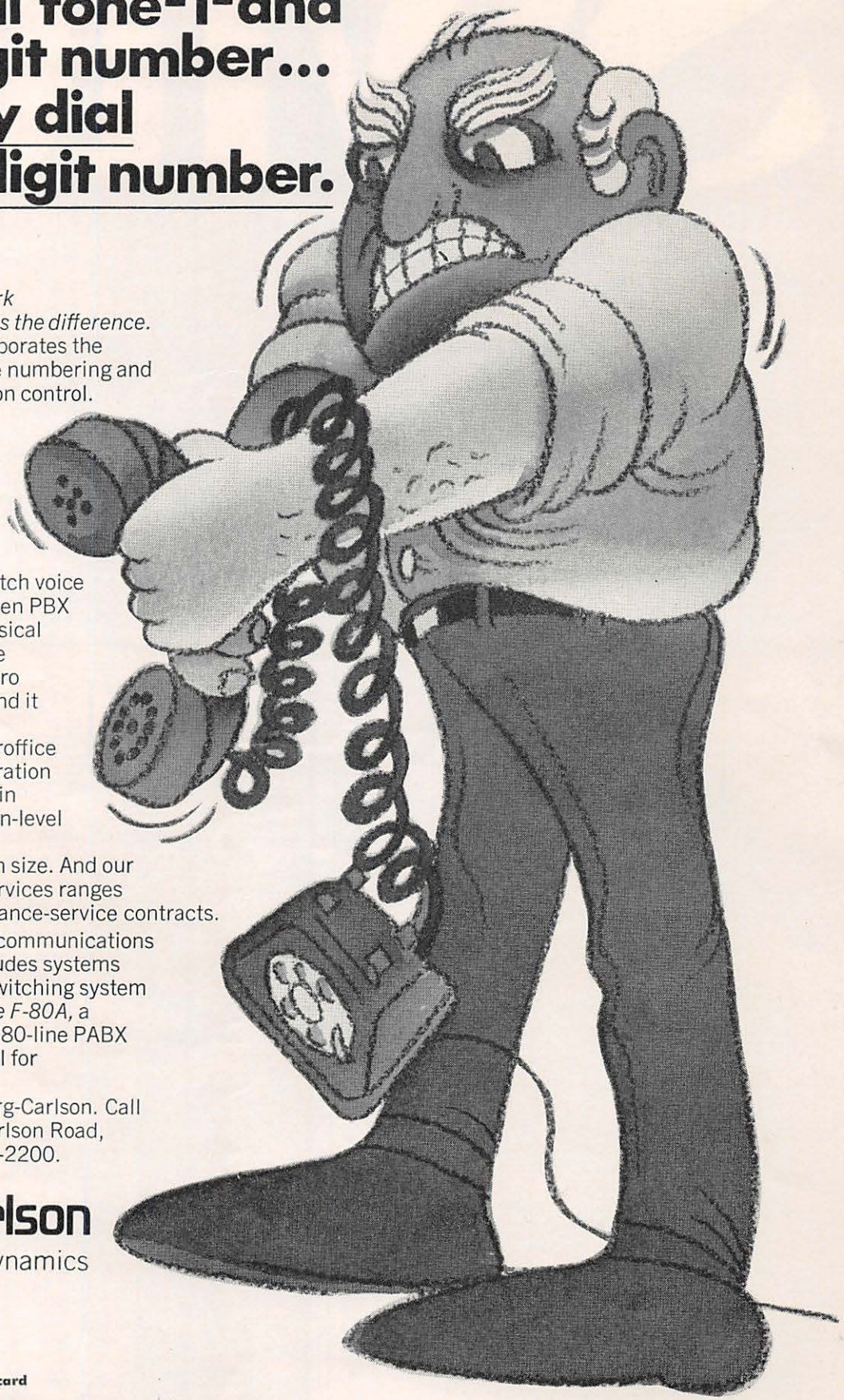
Circle 1 on reader service card

You can dial 5-wait for dial tone-143-25-wait for dial tone-1-and a seven-digit number... or simply dial the seven digit number.



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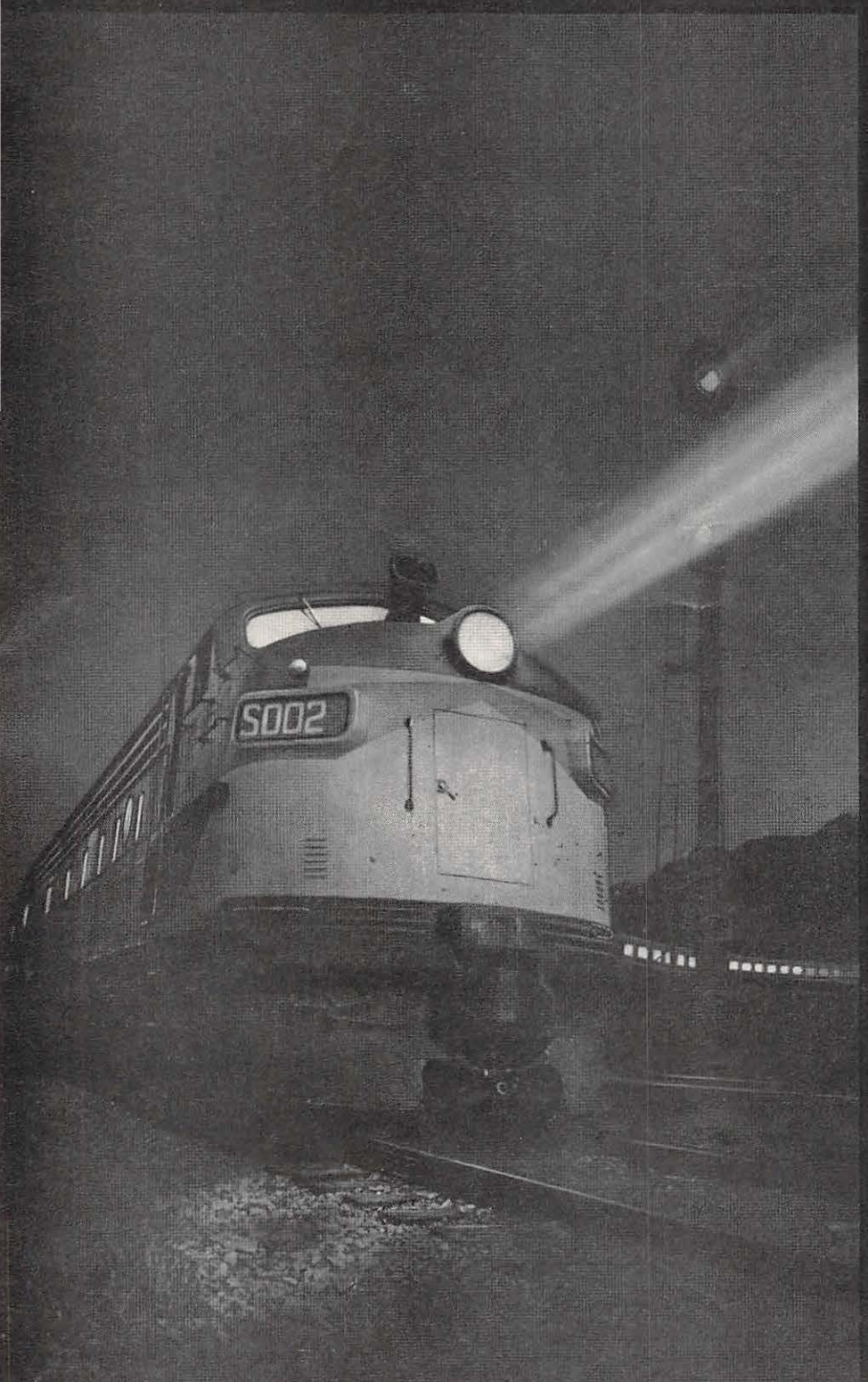
Switch



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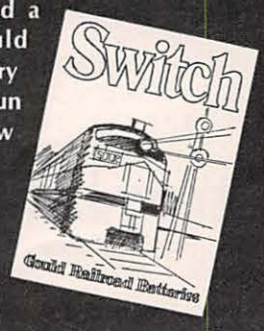

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JUNE 1971 VOL. 2 NO. 6

RSC RAILWAY SYSTEM CONTROLS

FEATURED THIS MONTH:

Santa Fe installs ACI at Argentine yard 13
Three-phase ACI program set for Argentine 14
Electrification highlights railroad meeting 17
How Servo's new hotbox detector operates 22
Detector scans trains moving 5 to 150 mph 26
How FCC decisions impact on railroads 31

DEPARTMENTS:

Editor's Corner: How complete is your edp? 38
News Briefs 10
People 36
Product News 28

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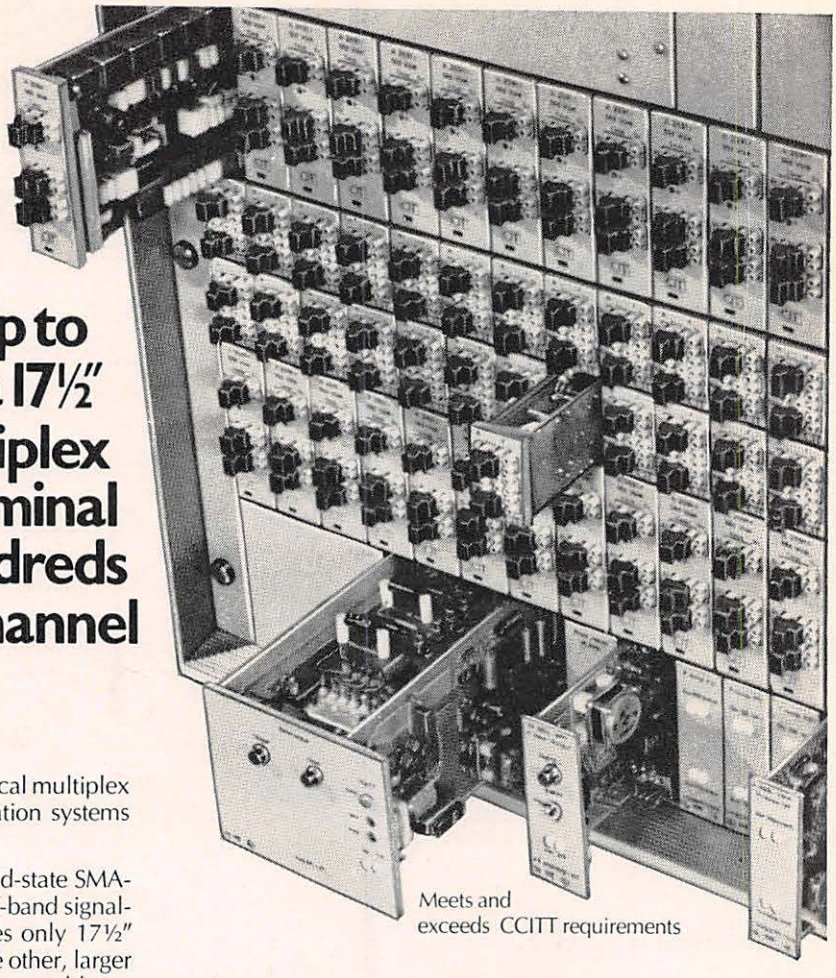


Pack up to 24 channels in a 17½" standard multiplex terminal and save hundreds of dollars per channel

Meets and exceeds CCITT requirements

This new CCS Type SMA-7/24 is the most economical multiplex terminal you can buy for low-density communication systems or low channel drop at intermediate stations.

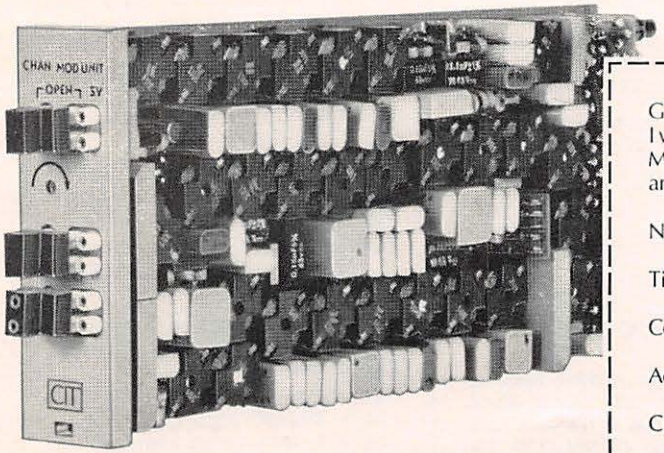
Smaller than its competition, the complete, all-solid-state SMA-7/24 package incorporates 24 channels with out-of-band signaling in 10 standard mounting spaces and measures only 17½" high. It occupies little floor space, fits neatly where other, larger units can't be used, or mounts conveniently on a table or counter top.

Operating in the 12 to 108 kHz range, the SMA-7/24 is a frequency division multiplex system specially designed to meet the requirements of through-route systems. It is compatible with microwave, troposcatter and hard wire systems used in telephone company, railroad, pipe-line and other "right-of-way" communications.

Compact packaging and low cost make the SMA-7/24 terminal particularly valuable for microwave stations which need only a few channels.

The SMA-7/24 unit features identical and interchangeable channel modems. Which means you reduce spares-storage, service and replacement problems. (Stock only one extra module for emergencies.) Since all units are plug-in modules, an SMA-7/24 terminal initially equipped with less than 24 channels can be expanded to full capacity at any time, quickly, easily, economically. You buy only the channels you need.

Learn how the SMA-7/24 multiplex terminal can make your multiplexing operation more efficient . . . more economical. Write for our latest brochure. Or call (212) 757-9130 ext. 37.



One duplex channel with out-of-band signaling is on a single plug-in module only 3½" high

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Circle 7 on reader service card

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NIFE nickel cadmium batteries are on the Santa Fe.

Powering switch machines and in signal line control service.

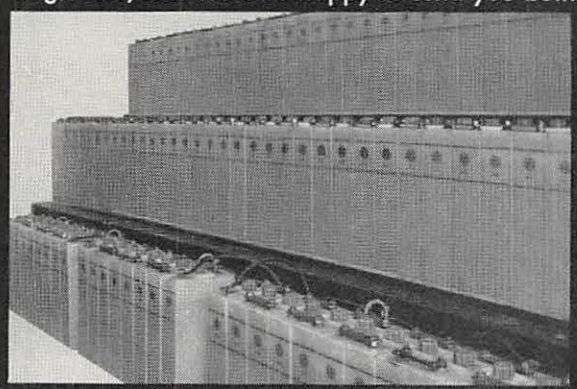
For example, when the main line Turner (Kansas) Interlocker Station was modernized in 1969, NIFE RP-91 batteries were specified.

A 110-volt battery handles 24 switch machines, with three low-voltage batteries for signal line control.

If battery reliability, performance, and freedom from maintenance are key factors in your signaling and communications system, select from the railroad industry's broadest range of nickel cadmium storage batteries. Specify NIFE RP and RS.

And when a high-rate battery is called for, such as for car retarders and stationary engine cranking, there's a special NIFE battery engineered to do the job economically.

Our railway signaling battery catalog has all the specs. Ask for our new maintenance manual for signal engineers, too. We'll be happy to send you both.



NIFE switch machine and signal line control batteries at Turner Interlocker Station

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If anybody offers you a price that looks better than ours, you'd better make sure you know exactly what you're getting.

We've just built a low-priced FDM data transmission system that's the best value on the market: the GTE Lenkurt model 25C. Go inside and take a look around . . . you'll find intermixable speeds from 110 to 600 baud. You'll find a built-in 20 mA local telegraph interface for on-premises printer applications. You'll find local/remote test features and a built-in carrier alarm lamp. You'll find it meets TTL, S-level and EIA/CCITT interface standards. And you'll find all the quality and precision we've been known for during 25 years of building data transmission systems.

The 25C comes as an attractive single-channel subset. Or the same duplex channel unit can be shelf mounted — up to 8 channels per shelf with a maximum of 18 channels (110 baud) on each VF line. So it lets you use just one voice channel rather than a lot of data lines. And it lets you do it at a very reasonable price. Add to that the 25C's economy of maintenance and you end up with a bundle of savings.

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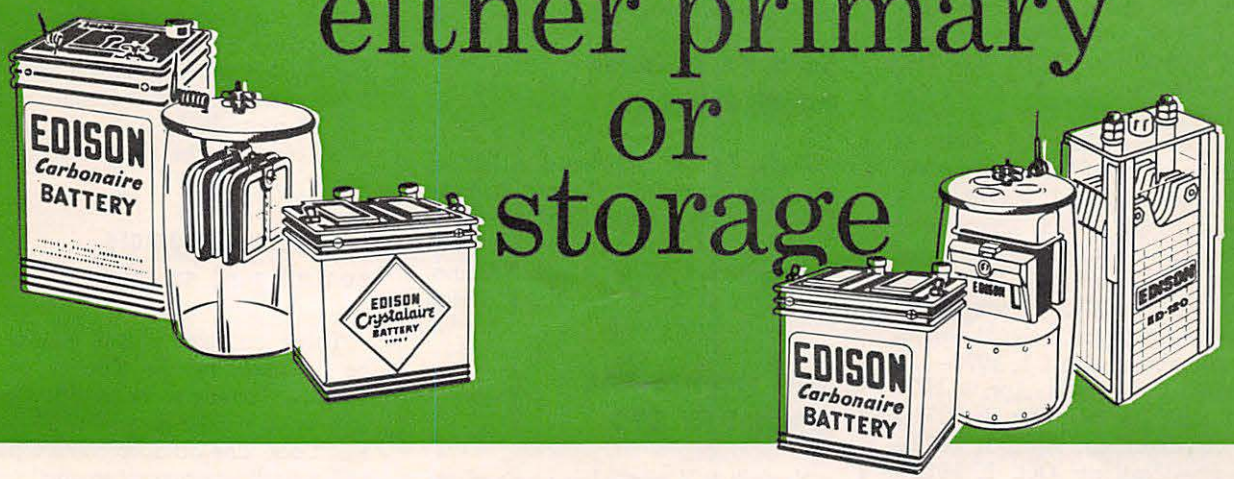

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News Briefs

Congress gives BofRS members pay raise

Legislation passed by the U..S Congress and signed into law by President Nixon brought a halt to the 2-day strike (May 17 and 18) by the Brotherhood of Railroad Signalmen against the nation's railroads. Congressional action provided a 5% pay raise retroactive to Jan. 1, 1970, to BofRS members. Also, the legislation provided for a 30¢ an hour raise to signalmen, signal maintainers and above retroactive to Nov. 1, 1970; an 18¢ an hour raise to assistants and helpers as of the same date. BofRS is forbidden to strike until Oct. 1, 1971 and urged to collectively bargain with railroads on all issues not covered by the recent legislation.

Before the strike the Grand Executive Council of the Brotherhood of Railroad Signalmen stated that the recommendations of Presidential Emergency Board No. 179 were unacceptable because they fell short of meeting the needs of the membership. The emergency board acting in a wage and fringe benefit controversy had recommended the following wage increases: Jan. 1, 1970—5% all classifications; Nov. 1, 1970—30¢ to skilled personnel (signalmen, signal maintainers and above); Nov. 1, 1970—18¢ to assistants and helpers; Apr. 1, 1971—4% all classifications; Oct. 1, 1971—5% all classifications; April 1, 1972—5% all classifications; Oct. 1, 1972—5% all classifications; Jan. 1, 1973—15¢ all classifications; and Apr. 1, 1973—10¢ all classifications.

The Board recommended that uniform minimum rates be established on a national basis which would eliminate existing regional rate differentials between the present eastern region and the western and southeastern regions.

P&PU to install ACI in terminal area

Peoria & Pekin Union plans to install 9 ACI Systems Corp. rail scanners multiplexed into 3 ACI decoding processors which will connect directly to the P&PU terminal computer. Peoria, Ill. is a terminal or rate-break point for 12 railroads.

P&PU expects that ACI will enable it to develop reports and services including inventory of cars to and from connecting lines; switch lists; joint facility accounting; demurrage accounting and protection for industries and performance of car repair facilities. Also, P&PU plans to introduce a new technique featuring supplemental labels which will allow the recording of repetitive waybilling code numbers for completely automated preparation of waybills.

ACI Systems Corp. will provide the programming and maintain the ACI scanners and decoding processors for P&PU.

EL to have more hotbox detectors

Erie Lackawanna has contracted with General Railway Signal Co. to install four hotbox detectors near Hornell, N.Y. These Wheel Thermo-Scanner units are the latest design which are optically gated.

Santa Fe to install hotbox detector

Santa Fe has purchased a hotbox detector system from General Railway Signal Co. for installation near San Bernardino, Cal., for the inspection of passing trains. This Wheel Thermo-Scanner unit is of the latest design and is optically gated.

N&W receives FRA approval for CTC

Norfolk & Western has received approval from the Federal Railroad Administration to install traffic control systems replacing existing automatic block signaling between Jacksonville and East Hannibal, Ill., about 64.5 miles; and between Pine Hall and Walkertown, N.C., 14 miles.

DOT awards contract to RCA for tracking

The third in a series of contracts to test advance methods of electronically locating and tracking transit vehicles operating in urban areas has been awarded to RCA Corp. DOT's Urban Mass Transportation Administration awarded a $202,823 contract for RCA to conduct tests to determine the effectiveness of a proximity signpost technique for tracking the movements of vehicles through city streets. Previous contracts in the series of AVM (Automatic Vehicle Monitoring) have been awarded to the Teledyne Systems Co. and the Cubic Corp. for testing other techniques of vehicle tracking. These systems are similar to a bus-monitor system installed last year by the Chicago Transit Authority and Motorola Communications & Electronics to keep track of some 500 CTA buses. (See RSC July 1970 page 26).

Southern to install new interlocking

Southern has ordered equipment from General Railway Signal Co. for an NX pushbutton control system for three interlockings at Chattanooga, Tenn. This project will involve the modification of two existing interlockings and the installation of one new interlocking. The facilities will comprise a total of 40 controlled switches within a one-mile area. The work is being done in connection with rerouting of L&N trackage in the area. The interlocking nearest the control office will be controlled via direct wire; the other two, via the type K2 code system.

D&RGW will remote control yard switches

Three outdoor control panels will be installed by the Denver & Rio Grande Western at its yard in Denver to provide remote control of 18 switch machines. The outdoor control panels will consolidate present manual operation of switches. Each panel will contain controls and indications and will be so arranged that the operator need only push a button to change the position of the switch from its previous position, as indicated by panel lights. The Speed-Frater switch machines have built-in signals to indicate switch positions. The equipment is being furnished by General Railway Signal Co.

Telpak rates & form up to federal court

The Second U.S. Court of Appeals in New York is reviewing the Federal Communications Commission's Telpak sharing decision. At present the Commission's sharing decision is stayed until the court rules on the matter. Following oral arguments on May 6, the court is expected to rule some time this summer. Also, the U.S. Court of Appeals for the District of Columbia

(Please turn to page 30)

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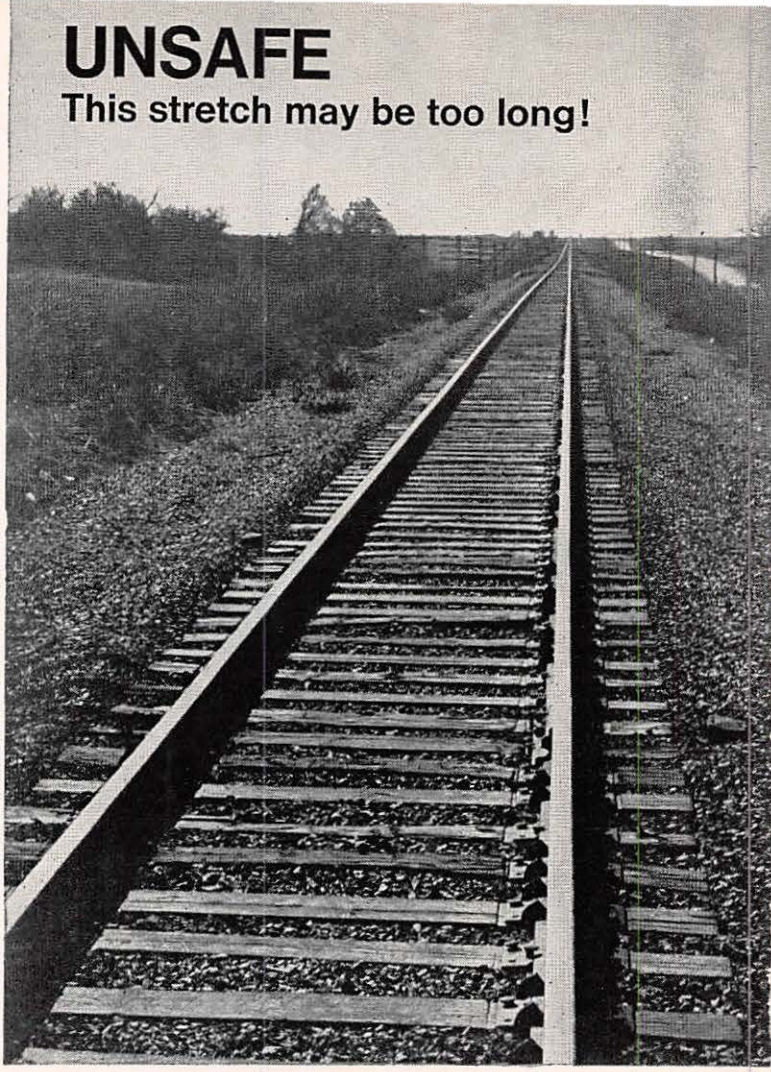


Our new rail-mounted SERVOSAFE® Hot Box Detective™ prevents axle burn-offs and derailments.

It's a good thing to have on your railroad.

But, for safety's sake, don't stretch a good thing!

Do you have long stretches of track without SERVOSAFE protection?

Recent studies have revealed that such factors as heavier car loadings, faster train speeds and greater accelerations have combined to increase the incidence of overheated journal boxes. This has prompted many railroads to review their spacing of hot box detectors. Up to now, the average spacing has been 25 to 30 miles apart along line-of-road. Under today's conditions, however, a hot box can develop in less than 25 miles and cause a derailment *between* detectors.

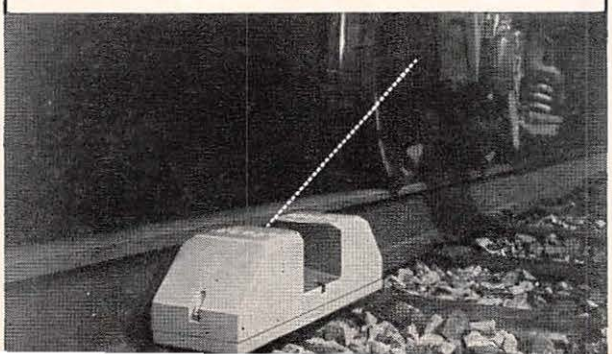
One solution becomes self-evident: closer spacing of hot box detectors for more protection. A SERVOSAFE system will not prevent a hot box—but it will detect, locate and warn of a hot box before the condition worsens into a dangerous, costly axle burn-off and derailment!

Will it cost you more to get this additional SERVOSAFE protection? Not really. Here are some reasons why not:

Our new Model 8808 SERVOSAFE system features patented rail-mounted scanners and solid state electronic data processing for the fastest, most precise detection of hot boxes. It allows remedial action to be taken *before* a failure occurs, and helps cut down the high costs of major salvage or replacement. The cost of installation and maintenance is appreciably reduced by eliminating the need for concrete foundations, special ties and expensive roadbed preparation. The rail-mounted scanner can be easily removed for maintenance or relocation. Finally, compare the cost of a SERVOSAFE with the $200,000 involved in just one derailment that could be prevented.

That's why most prudent, progressive railroad managements agree when we say, "More SERVOSAFE protection isn't costly—*lack of it is!*"

Model 8808 SERVOSAFE Hot Box Detective Rail-mounted scanner "looks" at journal bearing behind truck frame with a vertical, close-in target scan for greater uniformity and accuracy. Scanner is securely clamped to the rail (no drilling required). Accuracy is not affected by rail pumping, running or lateral movement.



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You know how important it is that the "new crop" of men in your department be familiar with RAILWAY SYSTEM CONTROLS. That is because this magazine is the best source of information about their work. It sharpens their skills by informing them how men on other roads tackle and lick the same problems which beset them.

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If you are a reader-and not a subscriber-fill out the card and mail it today!

Santa Fe installs ACI at yard

Santa Fe has closed the control loop at Argentine yard with the installation of 10 KarTrak automatic car identification scanners. "Argentine was chosen," says R. M. Champion, vice-president information systems, "because it is one of our most important yards. We decided to make a full-scale application of ACI where its use could be productive and where controls were very important."

Basically, ACI will monitor all moves in and out of Argentine, which are averaging about 6,200 cars daily and will peak to about 8,000 (counting both arrivals and departures). Five scanners each are located at the east and west ends of Argentine covering mainline and running tracks. Passenger trains, freight trains, transfer cuts and industry switching runs are scanned.

Each scanner is equipped with buffer storage for 500 cars, a calendar clock, message generator providing both prefix and suffix data, and the AAR communications interface, 8-level ASCII, polled. Data transmission from scanner sites is at 100 wpm over buried cable to an IBM 360/40 computer. Readout, on the associated model 40 printer, is a list of cars in train order from the headend showing initials and numbers.

Ultimately, the computer may match ACI-generated lists with advanced wheel reports received from Topeka's message switching computer complex. For the next several months, Santa Fe wants to gain experience with ACI, particularly, says Champion, to determine the necessary logic for programs for computer handling of ACI-generated data. The following questions will have to be answered if computer handling is provided:

—When matching ACI lists with advanced wheel reports, when can the assumption be made that an unlabeled or misread car on the ACI list is the car shown in that position on the advance wheel report? This involves many different situations.

—How do you reconcile the two lists if they differ in total number of cars and some cars are not labeled? Prior to installation of the ACI scanners and during a de-bugging period trains arriving and departing Argentine yard were visually checked. The checker telephoned car initials and numbers to the yard office where information was recorded and transcribed into inbound and outbound lists. Some errors occurred, particularly under inclement weather conditions.

Benefits of the ACI check, according to Champion, include the following:

—A more accurate list of all cars in train order.

—Elimination of the car checking positions.

—A reduction in the number of open records.

—Better control within the yard because a time and date will be established for every car arriving at Argentine. Eventually, exceptions to standard throughput times for cars can be flagged by the computer to alert operating supervisors.

During this interim period before the yard computer is programmed to automatically match the ACI lists and wheel report, the two lists are matched manually by yard clerks. Because the wheel report is printed showing cars in train order with the caboose at the top and working towards the locomotive—reverse of the ACI list—it is planned to have the computer reverse the order of cars in wheel reports. With full implementation of ACI on a system-wide basis, the wheel report reversal may ultimately be programmed into central computers at Topeka before distribution to individual yards.

Cars delivered to or received from two industries located between the ends of Argentine yard will not be scanned by ACI equipment. However, when these cars depart Argentine, they will be scanned.

To assure continuity of scanning and because simultaneous moves do occur on parallel tracks at yard entrances, the ACI equipment for each track is the stand-alone type system. The piggyback and container option is used so Santa Fe can identify trailers and containers with their associated flat cars.

"The 500-label capacity of the buffer storage plus the stand-alone type configuration provides us with the added insurance of not missing trains in case of failure, in communications or otherwise," says L. R. Thomas, general superintendent communications and signals. "We were able to make use of an existing underground cable plant.

"Also, we installed a 10 kw standby power plant (propane-engine type with automatic starting) at the equipment house at each end of the yard. This provides us with power should the commercial supply fail," Thomas said.

At each yard entrance an 8 ft wide by 15 ft long fiberglass building houses the ACI decoder, electronic equipment and air-conditioning unit. Standby power generator, voltage regulators, lightning arresters and track circuit equipment are in an 8 ft by 8 ft metal utility building separated from the ACI equipment so that vibration and noise will not disturb the electronic gear or personnel testing the ACI equipment.

The longest cable run from the ACI equipment building to a scanner mast is 230 ft at the west end of the yard. This west end ACI equipment housing is about 2 miles from the yard office computer center. At the east end of the yard, the longest cable run from ACI scanners to the equipment building is about 350 ft, and the equipment building is about 3 miles from the yard office computer.

MANAGEMENT INFORMATION

Santa Fe has installed 10 KarTrak automatic car identification scanners at its Argentine, Kan. yard to scan all cars entering and leaving the yard. In a phasing in to automatic generation of inbound and outbound train consists and ultimately of interchange reports, initially clerks are matching ACI reports with advance wheel reports received from other yards.

AT&SF uses AAR standard ACI-comms

By L. R. THOMAS
General Superintendent
Communications & Signals
Santa Fe Railway System

Due to the fact that the trackside scanning equipment could be located in groups of five at the east and west side of the terminal a favorable condition existed where five ACI decoder cabinets could be located in one building at MP 7.3 (west) and five decoders could be housed in a single building at MP 3 (east). This proves to be a desirable situation when consideration is given to the economy involved in having the minimum amount of housing and associated equipment. A certain amount of convenience and time savings is also gained in the maintenance of the equipment when it is possible to group multiple systems in such a manner.

As a result of our experience with the installation of test scanners at Winslow, Ariz. and Clovis, N.M., we felt that a more efficient method of the routing and terminating the large scanner to decoder cables inside the buildings was needed. As a result of this we ordered the two 15 ft × 8 ft fiberglass buildings with a special underfloor duct. This duct was designated to travel the full length of each building and it was made large enough to handle the large ACI underground cables plus grounding and AC requirements for five decoders. It was also evident at the time that other cabling requirements in the main equipment buildings, such as the data transmission lines to the outside and interface cabling between each decoder and a data cabinet could be routed via the underfloor ducts.

The ACI equipment with the exception of the activating track circuits, is installed and maintained by the communications department. The activating track circuits are installed and maintained by the signal department and the emergency power is installed and maintained by our shop extension forces which handle primary power installations.

The signal department provides the ACI system with three basic controls: train presence, train direction and wheel counter. Train presence and train direction is established by audio frequency overlay track circuits. The wheel counting is accomplished by Siemens non-directional wheel sensors.

Two different audio frequency overlay track circuits are used, extending eastward and westward from the ACI scanner. The length of track circuit is based on 15 seconds advanced warning time for the fastest train speed allowed on the particular tracks. This distance varies from 1,600 ft on the mainline tracks down to 950 ft for the yard lead tracks. These overlay track circuits drive a relay logic unit that feeds a train presence and direction signal to the ACI system. The lines to the ACI unit are fully protected with arresters.

The wheel sensors provide a contact closure to feed a pulse signal direct to the ACI equipment through underground cable.

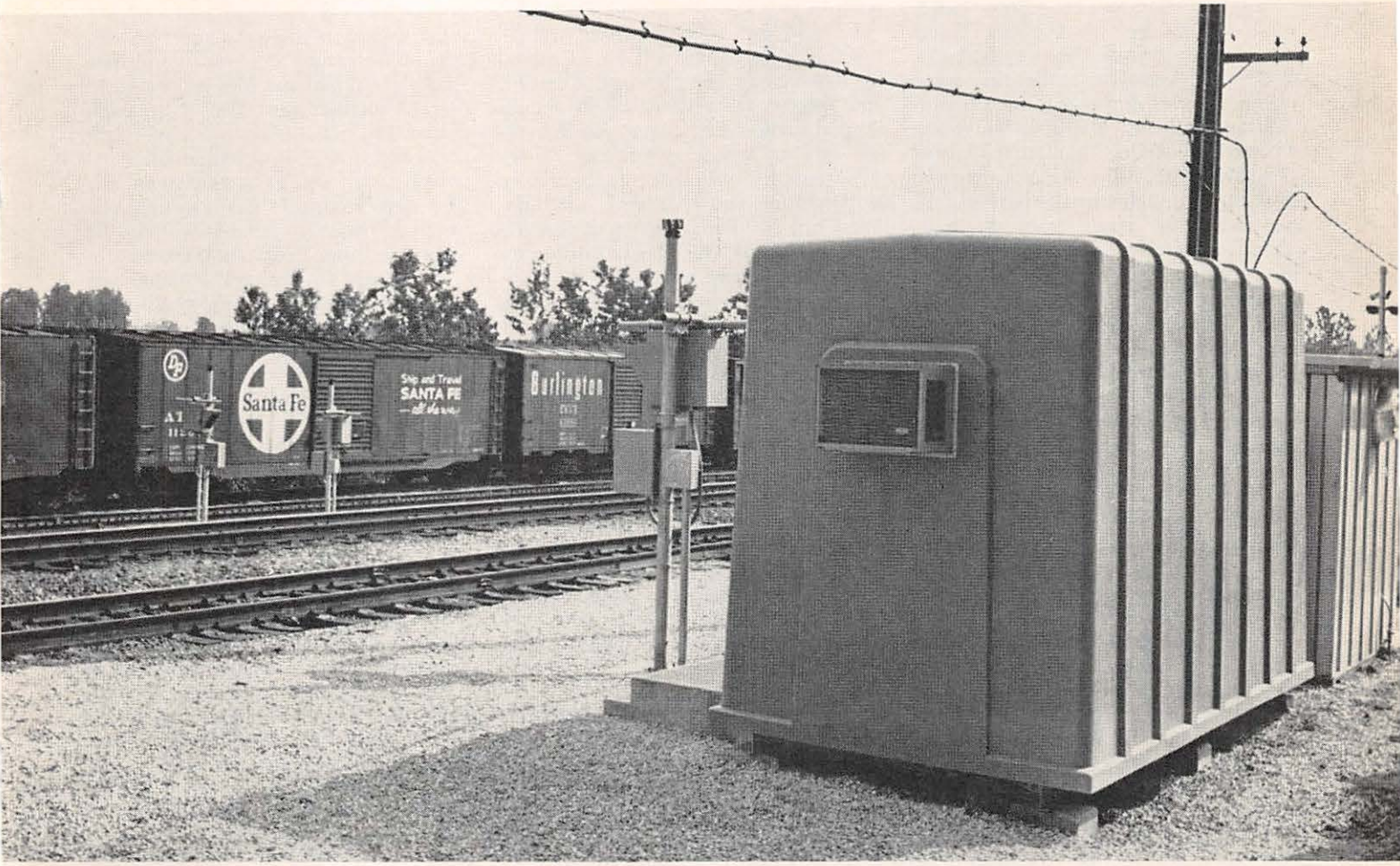
The communications department provides cable pairs from the computer location to each scanner site where two of the scanners are placed on one data circuit and three on a second data circuit by means of Teletype type SA 140 selectors. This makes a total of four data circuits from the two locations into the computer and transmission is by means of Lenkurt 25B data sets with the transmission rate at 100 wpm.

The ASCII interface cards installed in the Argentine systems were developed as a result of specifications drawn up by the Communication & Signal Section, AAR Ad Hoc Committee formed to study and develop ACI hardware standards.

The interface equipment makes two basic philosophies or modes of operation available to retrieve the information from the ACI buffer storage. These are currently referred to as system A and B. The interface equipment we have is capable of performing either method of controlling the flow of data out of the ACI buffer to the CPU. It is only a matter of changing the interface strapping options to switch from one system to the other. Our information systems people have chosen system A as the most suitable made for interfacing the data hardware on the Santa Fe.

The control for this type system requires a periodic polling sequence be forwarded over the transmission link from the CPU to the ACI selector at regular intervals. If a train has been stored in the decoder memory a data-ready condition will be forwarded to the selector to indicate that data is ready to be transmitted. The next poll from the CPU will set the control logic to the send mode and the stored train data will be forwarded. At the end of this message the CPU has the option of requesting a repeat message in which case the same message will be retransmitted, however, if the message is acceptable as first transmitted, the next poll received by the ACI logic will automatically decrement the train counter for the next train to be transmitted. This decrementing operation is, to put it more simply, a shifting of the address in the memory from the transmitted data to new data or to a "no traffic" condition. In the latter case, if the ACI label buffer has no more stored data the equipment is programmed to send a "NAK" to the CPU each time it is polled. Modes A and B also provide for requesting a "repeat line," however, this particular feature is not used at Argentine.

The IBM 360 model 40 CPU will poll each of the scanners in continuous fashion, receiving a NAK when the scanner has no data to send. When the scanner has data to transmit, it will acknowledge the poll by starting the data flow to the CPU. The data will consist of the generated header and the car label readouts followed by EOT. If the data transmitted from the scanner to the CPU is error detection free, the CPU will immediately revert to the polling sequence, which under our philosophy for control of the scanner, makes the next data message available for transmission, preventing re-transmission of the data which was previously completed successfully. If during a transmission, any abnormal message occurs, such as parity error or timeout, the CPU will address the scanner involved and transmit to it the ASCII "N" character followed by an EOT. The scanner will subsequently back up and retransmit the message in question when next polled by the CPU. Present programming provides for up to five retries on any single sequence number, after which polling ceases and the console operator is notified the device has



EACH STAND-ALONE SCANNER has a buffer store (500 labels), calendar clock and message generator.

been removed from service. Following investigation and repair if necessary, the device can be reactivated by the console operator.

As presently viewed, we propose to use the scanner input data in a three phase series of programs. In the first phase, scanner input data will be read from the disk storage queue, matched with the ACI conversion dictionary for converting assigned road code numbers to alphabetic road identifications. A listing of the converted scanner readout will be printed on the high speed printer. This first step has been accomplished in preliminary testing of the scanners, IBM 2702 interface equipment, and dictionary conversion programs. The available hard copy lists are being used to manually review and verify the completeness, accuracy, and reliability of the label reading, transmission, dictionary conversion and print programs. We will continue to manually review the available lists with the intention of identifying trends and patterns which may assist us in designing and writing better and more complete programs for moving into phase two.

Phase 2 will be devoted to the development and implementation of computer programs which will utilize ACI scanner input data to effect a more efficient and reliable operations and information data base for Argentine terminal. The first of these programs will match the scanner input with the available data records and re-order the data information to the sequence of the scanner readout. The sequence of the scanner readout will be considered "gospel" and while we have identified and admit to the known complications of unlabeled cars, unreadable labels, erroneous labels, erroneous check digits, etc., we anticipate that these conditions will improve rapidly as more and more scanner projects are implemented.

On the other side of the coin, we are also readily admitting to erroneous data information in the advance consist received by the computer at Argentine. This includes error car initial, error car number and out-of-sequence conditions. Here again, we expect improvement in the quality of the advance information. However, in the initial implementation we will rely heavily upon correction procedures developed for the data correction clerks who will have considerable responsibility in putting the final touches to the data list. They must manually insert missing data records to coincide with the scanner readout sequence. They must also correct or delete erroneous or excess data records which cannot be matched with the scanner readout. Having taken the corrective action prior to releasing a hump list, we expect subsequent humping, inventory, departing train, and departing interchange operations to be more accurate and efficient.

Phase 2 also requires the development of train and/or cut identification

which will permit the aforementioned matching of scanner readout messages to advance train consist data and other data information for cars in interchange service to and from connections. Trains into Argentine from the east generally arrive at Argentine with the same power units as departed from Corwith (Chicago) or Ft. Madison, Ia. when wheeled as advance consist to Argentine. Therefore, we anticipate using the lead engine number as the base matching factor for trains from the east. Should a search of the advance consist file reveal a "no match" to the engine number reflected in the scanner readout, it would then be necessary to direct the scanner readout message header and engine identification to a device (console typewriter, Teletype terminal, etc.), requesting manual entry through the device addressed, the proper train identification to be associated with the "no match" scanner readout. This procedure will require communication by data center personnel with informed persons remote to the data center to gain train identification and accomplish re-entry of data.

Trains from the west into Argentine offer a more difficult challenge due to the length of time and the possible change of power between the advance wheeling point and Argentine. To combat this problem we anticipate generating and transmitting to Argentine a power update message based on the "TAD" (Train Arrival & Departure) report of trains passing Wellington or Emporia, Kan. With a high degree of success in this effort, we expect to handle trains from the west in the same manner as those from the east and with about the same percentage of manual intervention required.

Trains outbound to the east and to the west will require entry of data header information as is presently required for wheel reporting. The data header would include the correct lead locomotive unit number which would again be used as the basic matching factor in relating to the scanner readout.

Cuts of cars delivered to connections in interchange will require the entry of data header information to complete preparation of interchange delivered reports. This data header does not contain an engine number but may need to be modified to do so. This would allow identification of interchange cuts using engine number as the basic matching factor. We are also investigating the possibility and reliability of matching individual car initials and numbers from the scanner readout with data records of cars available for interchange delivery. This may well negate the need for entry and matching of engine numbers.

Cuts of cars received from connections in interchange will be identified by the scanner identification, direction and engine label data which should properly reflect the owner road delivering cars to Argentine terminal. There is no reciprocity in interchange service at Argentine and that each road delivers cars in interchange to the receiving road's yard. Our checks to date indicate that a large number of the locomotives used in interchange service in the Kansas City Terminal area are not labeled. The locomotive must be labeled if we are to use ACI in interchange service. We are also researching the problem of receiving the scanner readout in most instances prior to having data information in the system for cars received from connections. Delinquent data entry will require programming exceptions but are not viewed as insurmountable. Beyond this exception, scanner readout and data records would again be matched and exceptions corrected prior to release of hump list or other data reports.

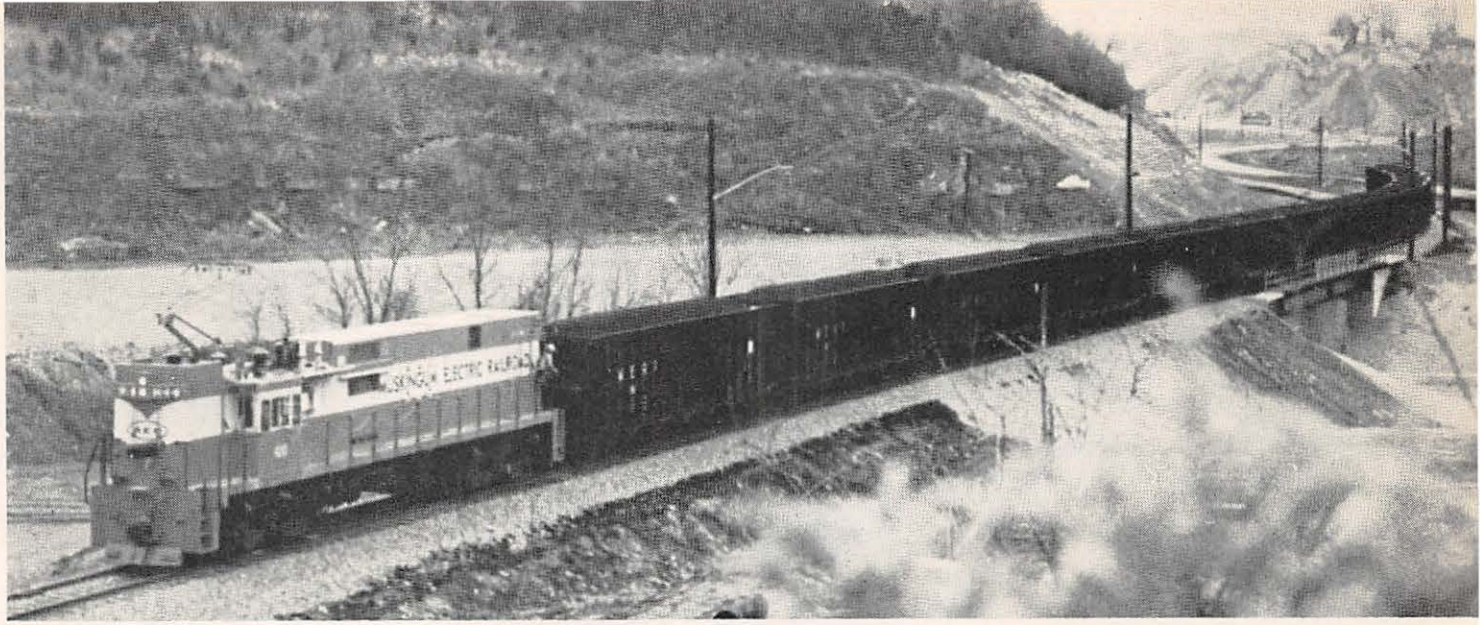
Make system more automatic

Phase 3 is presently viewed as the extension and polishing of Phase 2 to be as nearly automatic as is possible with the least amount of manual intervention required. Phase 3 will also include use of the scanner readout to trigger recording of data to local disk files, assembly, preparation, and transmission to the central CPU at Topeka as and when required. By nature, Phase 3 is highly dependent on the rapid development of the ACI program, from the labeling of equipment through the perfection of scanner reading and transmission and the quality of process programs and identification procedures. As the development of the Argentine pilot installation proceeds. we would anticipate new ideas and variations to be incorporated. It is difficult to say that the system could be packaged and used at other yards due to the unique conditions that exist in any yard, location of scanners, reciprocity in interchange deliveries, joint facilities, etc. It is anticipated that Phases 2 and 3 will provide the in-depth experience with ACI to permit development of sophisticated programs that can be used at other yards and also in regional concentrator computers for interfacing greater numbers of ACI scanners.

At Argentine, and perhaps more important at other yards and in concentrator computer systems, aside from car labeling and reading, the most important factor is the procedures for identifying scanner readout data and association of the proper train or interchange symbol information. Manual entry of this information must always be available as backup in case of scanner failure, unlabeled or unreadable labels on power units, loss in transmission, etc. The more automatic this operation can be made the more reliable we feel the system will be. It may be necessary to consider use of changeable labels on power units to establish automatic, and complete identification particularly on cuts of cars to and from connections. Each yard must be viewed and treated according to its particular needs and operational requirements. For this reason, regional concentrator computer systems must contain necessary logic to encompass the variable requirements of the yards with which it interfaces. Standardization and uniformity may prove most difficult where changes in local operations are required.

In addition to the three phases outlined above for local and regional ACI development, the central or master computer system at Topeka will require design and program changes to remain compatible with data input and dissemination changes resulting from the use of ACI. The ultimate philosophy identifies the onetime capture by the central computer system of waybill data for all cars moving loaded or empty in trains or interchange service. Subsequently, transmission of wheel reports and interchange reports for cars received and delivered would be replaced by the ACI scanner readout. Upon receipt by the central computer, the scanner readout would be matched with waybill data on file, necessary data files updated, reports such as the wheel report and interchange delivery reports would be generated and transmitted to the originating terminal and advance terminals and offices as necessary.

The degree of execution of the ultimate philosophy is dependent upon many things, including reporting of all waybill data, number of and location of ACI scanners and concentrators. With less than 100% coverage of yard and interchange movements by ACI scanners, we espect present data reporting methods to remain in use indefinitely for the protection of branch lines and small interchange points. Considerable research and identification for each segment of the railroad must be completed before support systems are given final definition.



MUSKINGUM ELECTRIC was first large-scale use of commercial frequency power in the U.S.

Signaling highlights meeting

At the April 1971 IEEE/ASME railroad conference, in New York, the effects of noise on cab signals, a cybernetic system to improve line capacity and the impact of electrification on signaling and communications were discussed.

An analysis of electrical noise currents in the running rails of sections of lines of New York City Transit Authority included the following:

—Noise currents produced by conventional switched-resistor and new chopper propulsion systems.

—Currents produced by substation power systems incorporating rotary converters and mercury and silicon-controlled rectifiers.

"Electrical noise studies were made on the above system, but only as to the effects on 25 Hz or 60 Hz track circuits used in the system," reported I. Cohen, maintenance of way, NYCTA; R. C. Sisson, research and development, General Electric; and D. F. Smith, transportation systems, General Electric, in a paper presented at the IEEE/ASME meeting..

The reason for these new studies is that with a continuous train control system, the running rails now contain additional information that is being continually transmitted to the on-board cab control system. This is the new concept for new lines and extension of existing lines. All possible studies concerning noise and its effect upon both the on-board electronic equipment and wayside electronic equipment were required to insure that the continuous train control system would be able to meet the safety standards of the present day signal system.

One necessary study was to determine the effect of a chopper-controlled car on the cab signaling system.

Tests were carried out on some 70 track miles with single-rail AC track circuits of which 4 track miles were equipped with audio frequency track circuits.

The overall objective of the noise analysis was to define the electrical noise currents in the running rails in sufficient detail to allow system trade-off analysis to be performed in the design of cab-signaling and train-detection systems on NYCTA property. Because a 990-Hz carrier was already being considered for cab-signaling, particular effort was to be directed toward defining the noise currents existing at this frequency. Also of special interest were the noise currents produced by a 200-Hz chopper propulsion system being tested on NYCTA. The objectives that were established at the beginning of the study were to determine:

(1) Noise currents produced by substations and propulsion systems.
(2) Noise currents existing at 990-Hz.
(3) Relationship between train length and noise-current levels.
(4) Improvement provided by a differential connection of two pick-up coils.

"Based on the highest frequency being considered for audio track circuits, it was decided that an analysis of the noise currents in the 0-Hz to 6-kHz frequency band would provide sufficient spectrum coverage," Cohen, Sisson and Smith reported.

"The noise environment analyzed in this report was factored into an analytical study which suggested that AM is an effective modulation technique. For the AM system a minimum signal to noise ratio was derived based on allowable interference. In addition, optimum frequency was derived for a given block length and ballast condition.

"Given the frequency it was shown that the power required for proper cab signal communication is a function of noise level, allowable interference, block length and ballast condition. These four factors are the basis for trade off decisions. That is:

"(1) Noise level can be reduced by

MANAGEMENT INFORMATION

Papers presented at the recent ASME/IEEE meeting indicate that cab signal systems can be designed that are compatible with electrified operation, especially where direct current traction power is utilized.

Although 60 Hz electrification and transmission lines do interfere with present signal systems, these systems can be modified to provide proper coordination. Conversion costs depend upon the existing facilities and the difficulties of construction. Field construction usually accounts for more than half the cost, with the remaining conversion costs about equally divided between signal and communications hardware and items such as wire and housings. A new system may cost less than converting an old one, especially for signaling.

improving rectifier operation and filtering the propulsion system.

"(2) In-track power can be reduced by increasing the allowable interference.

"(3) For a given ballast condition, the block length can be decreased to increase the signal level.

"(4) For a given signal level, the block length can be decreased to compensate for ballast conditions," reported Cohen, Sisson and Smith.

Development of a cybernetic system to improve line capacity—up to 30%—and do so at a cost on only 65% of that required for providing additional trackage was described by H. J. Autruffe, head of technical department, direction of research, French National Railroads.

"Practical experiments have been carried out on the Juvisy to Paris line, where up-traffic is particularly considerable during the morning peak-hour. On this line, suburbs trains on one hand, long-distance passenger and fast goods trains from South-Western France (Orleans, Bordeaux and Toulouse) converge on two tracks only," Autruffe said.

The cybernetic system consists of three subsystems:

(1) Signaling and routes—A number of automatic block signals have to be displaced for more regular spacing. All interlockings must be modern enough to make it possible to set the routes within the time-interval between trains.

(2) Traction—The accuracy of train running must be ±10 seconds to match with the time-interval between trains, especially where two up-through tracks converge. A special automatic running program has been installed on the driving units of multiple-unit electric sets serving the Paris suburbs. On long-distance trains, the driver is notified of his actual deviation from the time-table, but correcting the running of his train in order to cancel it, is left to him.

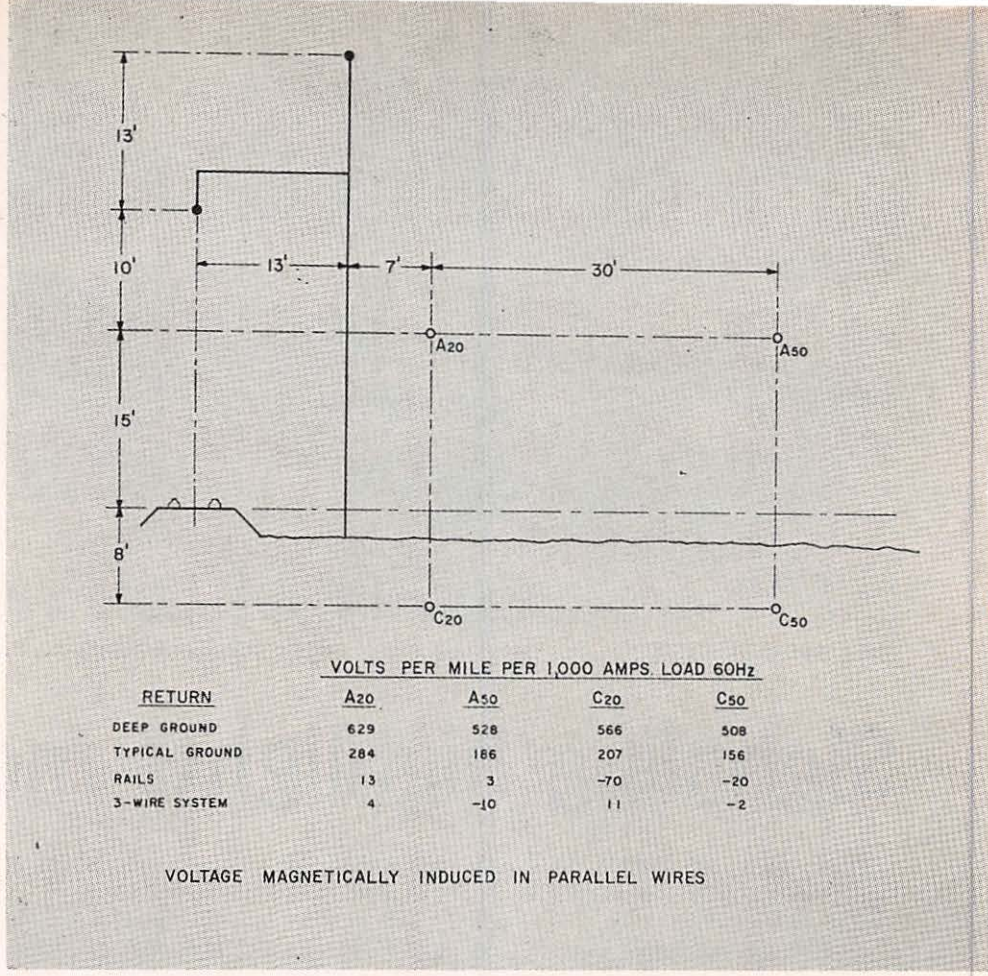
(3) Dispatching—The dispatcher has to interfere in case of an operating disturbance. He must therefore be rapidly aware of the beginning of such a disturbance, take a decision to cancel or reduce it, make sure that his decision is correct and transmit it for implementation.

"The positions of trains are received by a computer through trackside identification and locating devices. An associated visualizing system displays the distance-time train graph for a 25 minutes time-period, comprising the 5 minutes just elapsed and the 20 coming minutes. The prediction for the 20 coming minutes are based on standard, well-known schedules of suburbs, long-distance and goods trains. This graph is updated every 30 seconds. The dispatcher's attention is drawn on a possible conflict through a special mark appearing at the point whose coordinates denote the fictitious presence of two trains at the same point and the same time.

"The dispatcher can then make decisions like passing the train to another track, delay non-priority long-distance trains, etc., and will notify the computer of his decision. The computer will then update the future section of the displayed graph, taking this decision into account, thus enabling the dispatcher to ascertain whether his decision will be efficient. If so, he will confirm it to the computer for storing and transmission to the interlockings and drivers concerned," Autruffe said.

The best potential for electrification in North America is some 20,000 miles of track averaging over 40 trains per day, stated C. E. Staples, chief engineer-planning, Signal & Communications Division, WABCO.

The signal and communications facilities probably will have to be modified to provide proper coordination. And these changes have to be made without unduly interfering with the heavy traffic.



VOLTS PER MILE PER 1,000 AMPS LOAD 60Hz

RETURN	A20	A50	C20	C50
DEEP GROUND	629	528	566	508
TYPICAL GROUND	284	186	207	156
RAILS	13	3	-70	-20
3-WIRE SYSTEM	4	-10	11	-2

VOLTAGE MAGNETICALLY INDUCED IN PARALLEL WIRES

COMPARISON OF VOLTAGE PER MILE induced in parallel conductors.

"The principal effect of 60 Hz electrification and transmission lines on signal and communication facilities arises from magnetic induction. One thousand amperes flowing in the catenary with a deep ground return will induce about 500 to 700 volts per mile in parallel conductors of signal and communication lines at the usual locations.

The net induced voltage is greatly reduced if the propulsion current returns through the rails, inducing an opposing voltage. However, unless the propulsion system is designed to force the current to return through the rails, a considerable portion will return through the ground, resulting in a net induction of several hundred volts per mile in the parallel conductors. The three-wire propulsion system, with autotransformers, materially reduces magnetic induction—by cutting the catenary current in half, and by introducing an opposing voltage induced by current in the return conductor.

"The chart shows a comparison of the voltage per mile induced in parallel conductors at four typical locations for signal and communication lines, with the foregoing types of grounds. The induced voltages are based on 1,000 amp 60 Hz for convenience. Normal loads would be less, but fault currents can be greater. Faults in nearby or overhead power lines can induce voltages of

the same order," Staples said.

Electric induction may induce a voltage of about 10% of the catenary voltage on a signal and communication power line mounted on the catenary poles. This increases the insulation requirements. However, burying these conductors practically eliminates electric induction.

Ground potential conduction arises principally from the potential drop due to the rail and ground propulsion current. It primarily affects track circuits and grounded cable shields. The extraneous voltages and currents arising from induction and conduction are the effects of 60 HZ electrification which will likely force a change in the signaling and communication facilities. These changes include:

(1) Eliminating all wire circuits or placing them in buried, ferrous-wrapped, grounded-metallic sheathed cable, limiting cable length between repeaters, with twisted pairs or coaxial conductors, as far from the track as feasible.
(2) Converting track circuits to compatible types.
(3) Properly grounding instrument housings and equipment.
(4) Drawing power from high voltage lines or from the propulsion system.
(5) Providing protective devices.

Conversion cost depends largely upon the existing facilities and the difficulties of construction. Usually, the field construction accounts for more than half of the total conversion cost, even when minimized by factory-wired equipment housings. Field construction is particularly high in remote areas, or where weather is inclement much of the time. The remaining conversion cost is about equally divided between signal and communication hardware and other material such as housing, wiring and cable.

"Another field cost is the moving of signals and the addition of brackets to locate the signal heads where they can be seen, unobstructed by the catenary poles. Consideration should be given to the replacement of wayside signals by cab signals, which may reduce installation costs considerably, and pave the way for automatic train operation. A completely new system may cost less than a retrofit," Staples said.

In some installations, it may not be feasible to dispense completely with signal and communication wires along the railroad right-of-way. A study needs to be made for each installation to determine the most economical way to handle buried or aerial cable, possible location of such facilities and availability of space, construction and trenching costs, and possible leasing. Radio channels may not be available as an alternative.

Track circuits should be high-level coded AC double-rail track circuits suitable for cab signaling and CTC, expandable for automatic train operation.

The power level must be high enough to provide satisfactory operation through interference. The track circuits should be coded (or modulated) at compatible rates for maximum security. Frequencies must be selected to preclude adverse effects by any interference, he said.

Double-rail track circuits reduce interference, improve broken rail detection, and are required for safe operation of continuous cab signaling. They can be justified economically over single-rail track circuits through longer track circuit lengths and lower propulsion losses.

Track circuits can be installed without insulated rail joints, but this will generally increase the installation costs because more circuits are required, since a number of frequencies have to be used to separate functions and since operable length varies inversely with frequency.

For many railroads, the lowest cost approach would be to convert to 100 Hz coded, phase-selective track circuits. It is directly applicable to cab signal and automatic train operation, with or without cab signals.

"The amount of facilities—and their cost—are only partly related to the distance covered. The major factors are the density and variety of traffic which determine complexity of facilities.

"Recent budget estimates on four railroads in North America have indicated a signal and communication conversion cost of about 15 to 25% of the total electrification cost, of about $60,000 to $120,000 per track mile.

"To promote railroad electrification and rehabilitation requires systematic study and planning—using the systems approach to achieve an economical balance between capital expenditures, annual operating costs, and utilization of equipment and facilities", Staples said.

"We are talking about big projects. Coordination and construction can reduce costs. We need to guard against unrealistic operating demands for speed and flexibility that preclude economies. We need to protect the public as well as railroad facilities, by minimizing interference at its source. Government supported grade separation can materially reduce costs.

"There is little doubt about the superior capabilitiy of electric locomotives. But to convert that capability into superior operating performance, on a busy railroad, requires adequate signaling and communication facilities.

"When upgrading motive power, it is even likely that a completely new signaling and communication system, with associated track changes, can be economically justified. Conversion to a cab signaling system may even save money, and pave the way for automatic train operation.

"Modern centralized traffic control, with automatic train dispatching, increases track capacity and improves equipment utilization. In combination with cab signaling and overspeed control, it can pay for itself by the savings in power costs.

"When considering electrification, we need to fully exploit its basic advantages—not only in the territory to be electrified, but for the entire railroad. Signaling and communications can enhance and enforce these advantages", Staples concluded.

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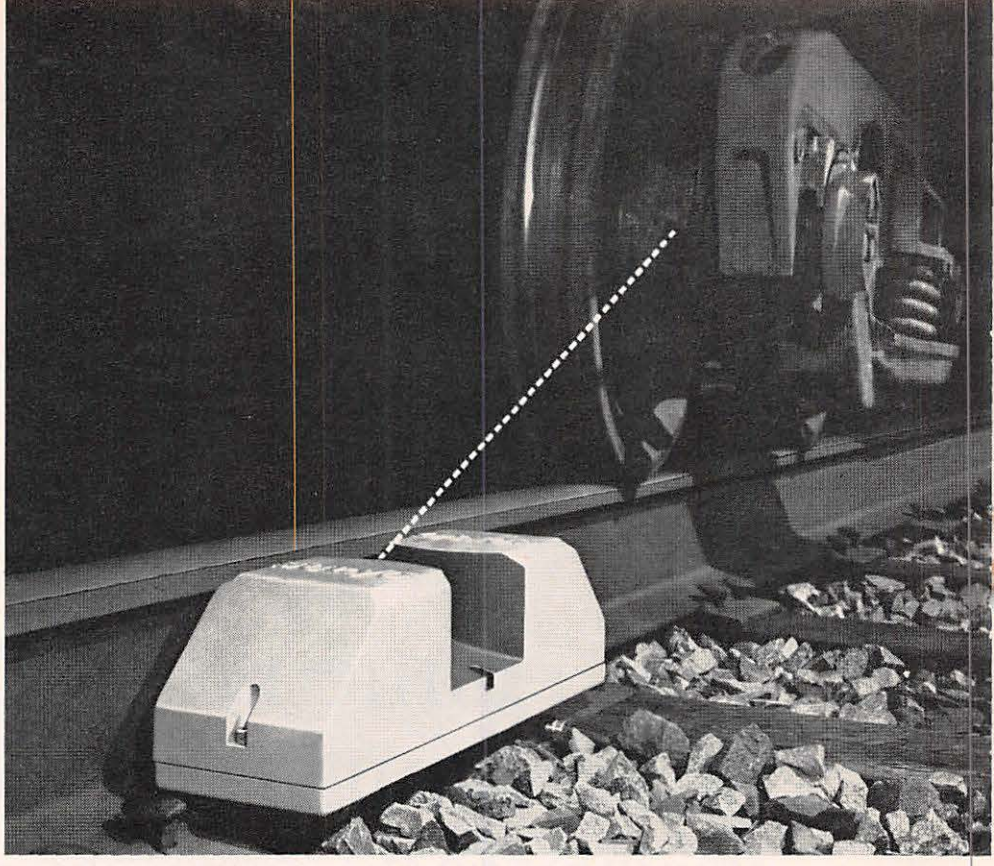

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Manager Application Engineering
Servo Corp. of America

The primary objective of hot box detecting systems—the early detection of bearing overheating—has been made more difficult to achieve with the increased speed of modern trains. While the internal temperature of the bearing rises with increased train speed, the external manifestation of overheating is reduced by the cooling effect of high velocity air stream on the scanned surface. The trend to single-track operation has compounded the problem since one direction of train movement entails scanning the surface of the friction journal housing which is directly influenced by the air stream.

The objective of the scanner placement is to permit the total and identical scan of all targets while retaining the ambient radiation reference on a part of the car body.

Common journal dimensional variations cover a range from 5″ x 9″ to 6½″ x 12″ within both the friction and roller bearing categories. Variation in the journal length dimensions produces a proportional difference in the outer edge of the target with respect to the gage line. Adding the factor of wheel diameter variations (from 28″ to 38″) results in a substantial displacement of the target in the vertical plane.

The cooling effect of the air stream on the journal housing is probably the greatest single deterrent to the early detection of bearing overheating by infra-red scanning techniques.

The scanned surface of the rotating end cap roller bearing is constantly changing its position with respect to the air stream resulting in all surface regions being cooled equally. The signal levels therefore are the same regardless of train direction.

However, in the case of the friction journal, which is more susceptible to overheating, a different situation prevails. A thermal gradient exists across the bearing and wedge assemblies which are interposed between the journal and the outer housing. As the train speed increases, the temperature of the internal journal and bearing interface rises whereas the air stream cooling effect on the scanned surface increases, offsetting much of the indication of internal temperature rise available to the scanner.

This cooling effect is particularly noticeable when the train motion is oncoming to the scanner aperture. Under this condition, the front surface of the box, directly influenced by the air flow, is scanned. Reduced signal amplitude on friction journal results. The foregoing is the reason for scanning the trailing surface of the box when the detector is installed on single-direction track.

Inasmuch as the scanned surfaces of the roller and friction housings protrude outboard of the frame, they are affected directly by a prevailing wind or sun condition on one side of the train. This adversely affects the side-to-side signal balance which is a factor in the application of automatic alarm systems. In addition, the protuding housings are subjected to a reduction in radiation caused by the cooling effects of rain.

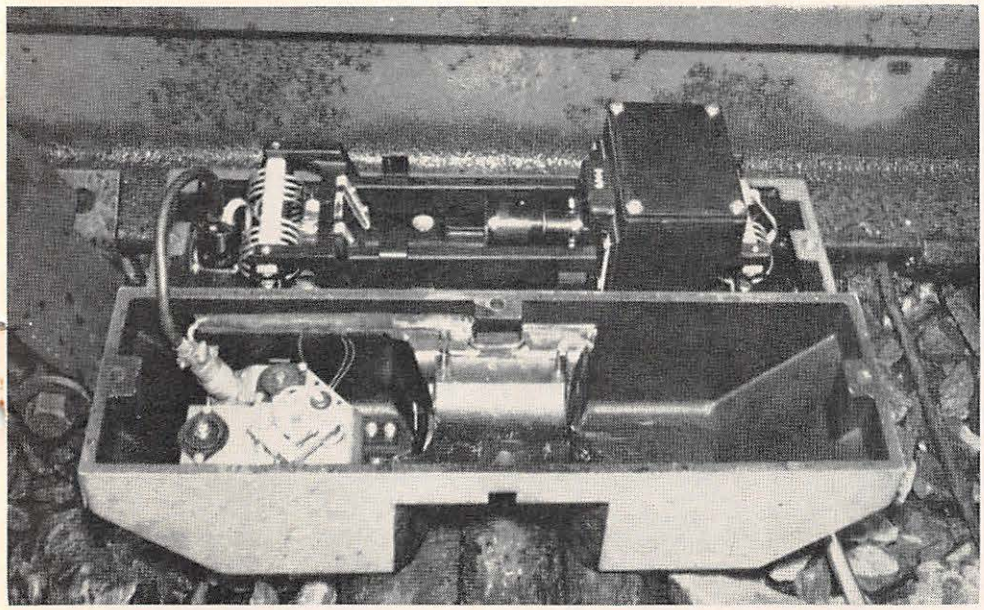
The basic detector problem caused by snow is not related to the extent of the snowfall—which can be adquately cleared from the immediate scanner vicinity—but to the effect of the swirling snow during train passage. Swirling snow conditions exist after the snowfall has ended.

The interjection of snow particles between the scanner and the target results in signal attenuation. Such attenuation rises with increasing distance between the scanner and the target.

A large investment in scanner heater power is required to maintain basic system operation during periods of heavy snow and low temperatures. Reliance is therefore placed on the commercial power sources to meet the high power demand.

Power outages result in total loss of system operation. In addition, false indications may result from line transients beyond the regulating range of line voltage regulators. The ideal objective of direct and total target coverage, with identical scanning within a given bearing category, is not possible when scanning the housings in a region outboard of the frame. Truck skewing, plus shifts in the static scanner alignment point with train presence, place additional burdens on the accuracy of the scanning device.

A conclusion was reached that if it were possible to scan the bearings from a point close to the gage line, the ideal requirement of a direct and total bearing scan, with identical scanning with-



RAIL-MOUNTED DETECTOR (left) scans inside, has bolometer (top).

MANAGEMENT INFORMATION

The new model 8808 hotbox detector scans the vertical surfaces of journal housings behind the truck side frame. This rail-mounted scanner provides a more uniform scan of both roller and friction bearings. Other advantages include reduced installation costs, reduced power requirements, reduced maintenance and constant target-to-scanner relationship. Scanners and transducers because they are mounted on the rails move in unison; no shift in alignment with train presence; and no need for realignment after ballast tamping operations.

Model 8808 scanners and associated junction box equipment can be retrofitted into all prior Servo. Corp. hotbox detector systems with circuit changes.

in each bearing type, would be realized. In addition, a vertical scan parallel to the gage line would completely eliminate the problem of vertical target displacement caused by wheel diameter variations, since the bearings are merely scanned sooner or later within the gating period determined by the wheel transducer placement. Finally, such a scan would retain the desired radiation reference of the car body to which the radiation of the target is compared.

An area inboard of the truck frame on the friction journal housing is accessible to a scanner with an optical system parallel to the rail run and positioned in a region 6½" from the gage line. The vertical angle of the optical system must be selected to enable fully scanning the inside journal (adjacent to the truck springs) before a portion of the truck intercepts the line of scan.

Although the frame width and the outside frame dimensions vary considerable with increased journal size, little change takes place in the position of the inboard vertical section of the frame relative to the gage line. A scanner viewing the inside frame area therefore sees little difference between a 5" x 9" or a 6½" x 12" housing. The larger housings merely increase the area available for scanning.

A typical optical system, which accepts only radiation from a small diameter spot, is fully resolved on the box from bottom to top. Such a sharp optical system, parallel to the gage, readily avoids the radiation from the brake shoes. Open and missing lids, which result in increased cooling of the surface accessible to an outside-frame scanning device, have no effect on a behind-the-frame scan.

Some freight cars are equipped with roller bearings inserted in friction journal frames. The lid is removed, thus cooling the region normally scanned in the outside frame area. This type of bearing arrangement appears as a friction journal to both scanning approaches. Overheating will be detected by heat transfer to the journal box via the bearing adapter. The location of the adapter, in combination with the increased cooling due to the removed lid, favors the inside frame area.

Unlike the friction journal, where some heat is transferred to the journal box walls by the oil and oil-saturated pad, the adapter is the sole means of heat transfer to the top of the box. It is therefore important that the top of the box be scanned in this modified box.

On a rotating end cap roller bearing the cap temperature is elevated by the bolts which are threaded into the journal. When scanned from the outside-frame position, the cap produces relatively high signal levels. On 6½" x 12" roller bearings on 36" wheels, the bearing outer race is encountered in lieu of the cap, since the target position moves outward and upward when compared to a 5" x 9" journal on a 33" wheel. The outer race is in most cases at a higher temperature than the cap. Such high signal levels from the cap and race restrict the sensitivity or gain setting of the detector, thus adversely affecting the early detection ability of the system.

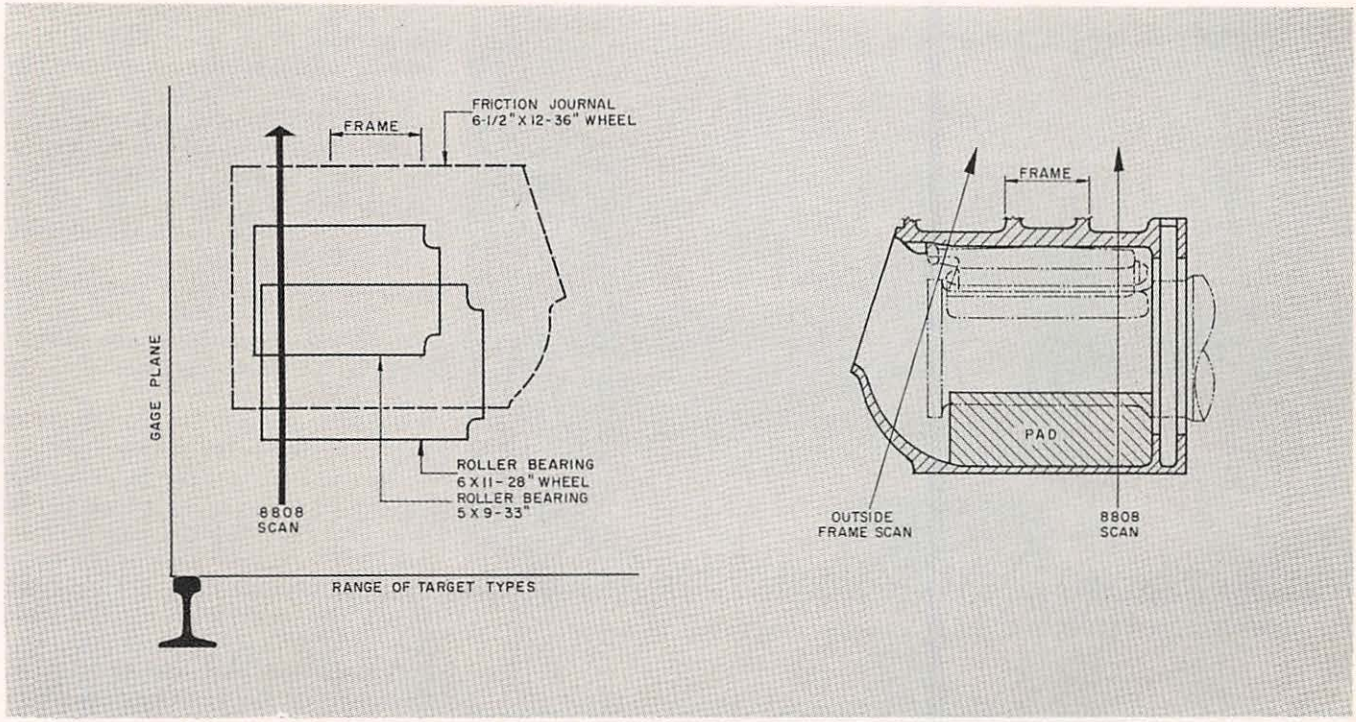
The area of the dust guard is at a lower temperature due to the closer proximity of the large heat sink comprised of the wheel and axle assembly. Reduced signal levels derived from the scan of the dust guard area permit advancing the system gain without encountering excessive roller bearing amplitudes. Increased system gain, which is one of the salient features of the model 8808 system, enhances the early detection capability of the system on the friction bearings.

An orientation selected to optimize the scan on the troublesome friction journal encounters on a roller bearing either a portion of the cap, or the outer race together with a part of the frame, as the wheel diameter and journal size variations are brought into play.

The importance of a consistent scan of this type of bearing is ever-increasing as the percentage of roller bearings in service rises, and infrequent but rapid failures occur.

Model 8808 hotbox detector system has scanner clamped to the rail. The vertical angle of scan is 45° parallel to the rail with a ¾" field of view. The center of the scanner aperture is approximately 6½" from the gage line.

Major features of the scanners are:



VARIOUS BEARING HOUSINGS are visible (left) to 8808 detector. Others view at angle (right).

—Casting is of ⅜"-thick aluminum. Overall height enables installation on rail sizes from 112 to 155 lb.

—Shutter, optical frame (mirror, lens and amplifier section), clamps, baseplate, and connector for cable with hose fitting are major components.

—Cover attached by four Allen head bolts, is removable from baseplate. Gasket provided on baseplate to minimize dirt and water entrance.

—Amplifier has integral 2 M/S bolometer with sun filter. Pre-amp assembly has replaceable operational amplifiers and field effect transistors. Printed circuit board eliminates movement of wiring.

—Optical frame is mounted on coiled shock mounts which have good memory characteristic; no fatigue or deterioration as in rubber shocks. Vibration basically is in vertical plane which minimizes shift in field of view on the target.

—Snubbers are provided to restrict the motion of the optical frame in the event of a conceivable mechanical resonance. Snubbers prevent mechanical contact with sides of the scanner housing.

—Thermostatically controlled heaters are located to keep optical path free of ice or snow.

—Sloped baseplate areas with drainage holes facilitate scanner drainage.

—Holes are provided in the baseplate to enable scanner positioning with various rail sizes.

—Basic "U" shape of scanner housing protects optical system, assures mirror cleanliness. Sloped middle section is blackened to minimize reflections. Housing is painted aluminum to minimize sun loading effect.

—Scanner has cable with connector terminated in the scanner junction box.

Scanners are located over ties to enable installation with standard tie spacing. Dragging equipment deflectors are also clamped to the rail. Gating transducers are spaced on 16" centers. A junction box is assigned to each scanner which permits rapid scanner disconnect. The scanner cable is 15 ft long to enable placement of the junction boxes on the same side of the track for ease of installation and personnel safety in double track territory. The scanner and transducer junction boxes are installed in an area to minimize drainage problems.

As in prior systems, it is recommended that the equipment be installed on tangent track where no braking takes place, and that tight gage be maintained for a distance of 100 ft in each direction.

The combination of bearing load plus variations in the point scanned on the roller bearing housing with bearing size and wheel diameter changes, results in a relatively wide range of signal levels in the outside frame scan. The more consistent scan of the dust guard results in a better amplitude averaging of roller bearing signals. In effect, the small amplitudes are elevated and the high amplitudes are compressed.

Roller bearing side-to-side balance, which is an important factor in automatic alarm systems, is improved in the 8808 scan. This is also primarily due to the increased scan accuracy on these bearings.

Note in Fig. 1 the normalization of the roller bearings in the center portion of the tape. In the upper rail-mounted portion, the roller bearing indications range from 3½ to 8mm while the ballast-mounted portion ranges from 2 to 12mm.

Another advantage evident in the tape is the tendency to minimize the number of small individual roller bearing signals. On the third roller bearing from the right hand side the small signal noted on the second truck of the bottom tape is checked at normal level in the 8808 scan. Reduced levels on a particular roller can cause a problem to differential alarm systems.

Fig. 2 illustrates the benefits of increased system sensitivity. Note that in the early stages of overheating, the amplitude of the signal on the 8808 scan is greater than that provided by the outside frame scan. Attention is called to the car directly adjacent to the "rail mounted" designation on the upper portion of the tape.

The sensitivity of both scanners was advanced during the period when the tape was taken. The rail-mounted scanner was operating at 14mm for 130°F/amb. and the ballast scanner was operating at 9mm for the same generator setting. Normally the 8808 is set for 12

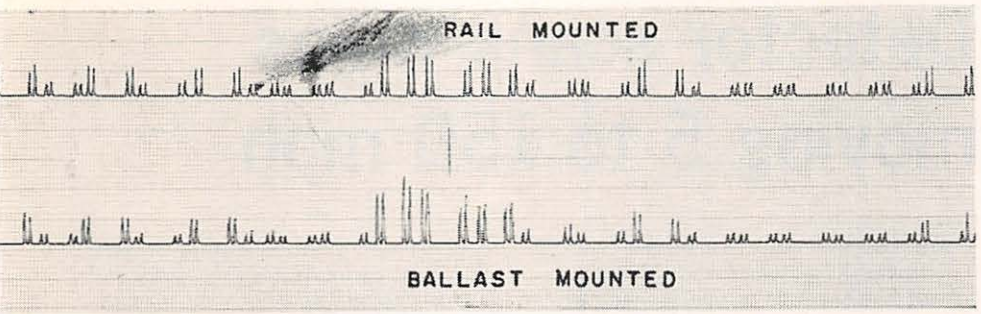


FIGURE 1: Normalization of roller bearings in center of tape.

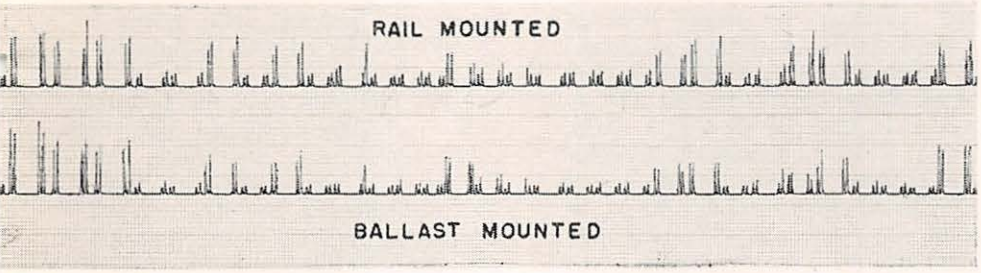


FIGURE 2: Signal amplitude of 8808 scan (top) is greater.

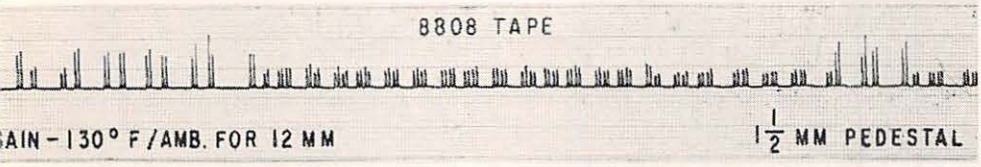


FIGURE 3: Channel of 8808 system using transistor gate circuit.

mm and the 7707 system for 8mm (ballast-mounted scanner).

In addition to a more uniform scan of the targets and increased system sensitivity, there are numerous installation and maintenance advantages accruing to the 8808 system employing rail-mounted scanners:

—Reduced installation costs. No foundations required; no special tie installation, tie cutting or tie relocation required; reduced overall power requirement; no rail drilling.

—Reduced maintenance. Permanently aligned scanners; reduced frequency of optical system cleaning—30 day cleaning periods are recommended.

—Constant target-to-scanner relationship—No rail run problem. Scanners and transducers move in unison; no shift in alignment with train presence; no need for realignment after ballast tamping operation.

The projection of friction journal housings outboard of the frame was, no doubt, intentional in the design to appreciate the cooling effect of the air stream on the housing. Little resistance to the air flow is therefore realized outboard of the frame.

In the scan area behind the frame, resistance to air flow is encountered. The journal housings and the large center frame structure comprise a substantial barrier to the free passage of air through this region of the truck.

When the train is moving in a direction to scan the journal bottom-to-top, the signal output from the lead journal is lower in amplitude since the frame, which acts as a heat sink, is attached directly to the scanned surface. The heat siphoning effect is not present on the trailing journal with the result that a higher signal is realized. Despite the effect of the heat sink on the lead journal, the signal output on this journal in the behind-frame scan, in many cases, approaches the signal level of the trailing journal.

In the normal direction of truck motion, the air stream is not directly on the lead journal surface being scanned in either scan approach. The increased signal on this journal in the behind-frame scan, therefore, appears to be due to the reduced rate of air circulation in the sheltered region behind the frame, permitting a higher scanned surface temperature.

The outside frame scan is at a dual disadvantage when the direction of train motions is such that the journal is scanned top-to-bottom. (Truck motion is into the scanner aperture.) The air stream flows directly on the scanned surface on the lead journal and the frame heat sink influences the output on the trailing journal. The net result is reduced output on both journals.

Since the scanned surface of the trailing journal is in the shadow of the air stream barrier comprised of the lead journal and the center frame structure, a higher radiation level is realized. The increased air velocity on the outside frame area as train speed increases further emphasizes the advantage of the sheltered Model 8808 scan.

In both bearing types, the frame affords a measure of protection to the model 8808 scanned surface against a prevailing wind, rain or sun condition on one side of the train. In the case of the friction journal, the inside housing surfaces adjacent to the spring nest are benefited by the frame structure.

One of the important features of the model 8808 system is the low basic system power requirement of 500 volt-amp which includes the scanner heaters. It is therefore possible to operate scanner heaters, from a 24-volt battery through the use of an inverter.

The use of a battery source enables standby power in the event of a commercial power failure. In addition, power line transients outside the range of line voltage regulators cannot influence the system signal output.

The rail-mounted scanner, positioned at a higher level than the ballast scanner, does not have to contend with the problem of surrounding snow intercepting the scanner optical path to the degree encountered in the ballast scanner. Heater power is invested with the primary intent of maintaining the optical path free from obstruction, and secondarily to limit the ambient range to which the bolometer is subjected.

The main problem of equipment performance under snow conditions is the swirling snow occuring during train passage which persists for long periods after the snow fall has ended. Particles of snow obscure the clear optical path to the journal housing—the longer the optical path, the greater the signal attenuation.

Since the scanner angle is at 45°, a shorter path to the target exists. The distance in the model 8808 system is 28″ as compared to 43″ in the ballast scanner. While it is not possible to eliminate the effect of swirling snow attenuation, minimizing its effects permits the detector to perform its primary function of detecting dangerous conditions of bearing overheating.

Additional features of the model 8808 rail-mounted hot box detector system include: Speed range from 5 to 150 mph. System gating is speed proportional using a transistor gate circuit driven from a two-transducer arrange-

ment. Storage and readout gating with constant pulse width output eliminates truck skewing effects, as well as recorder amplitude roll-off problems at high train speeds. Transducer spacing is decreased from 28" to 16" which reduces the possibility of false indications. The gating trigger is accurate regardless of train direction or speed. The system has an operating ambient temperature range from −30° to +140°F. (System has performed well in temperatures as low as −44°F in Canada)

Fig. 3 displays a channel of the model 8808 system with the foregoing gating arrangement. The system sensitivity was set for a 12mm recorder deflection with a test generator setting of 130°F/amb. The pedestal is set for 1½mm which is the recommended level for the model 8808.

The signals derived from the scanners and transducers are fed to the data processing unit over shielded cables. The data processing equipment is mounted in a 6-ft communications rack equipped with ARR terminals to accommodate the cables. A typical arrangement, includes the following equipment:

(1) Recorder—Furnished with ink or thermal writing. Uses economical 3" paper. Recorder has a reverse paper drive to enable reappraisal of tape. A third event marker pen is standard equipment.

(2) Test Panel—This unit comprises a motor-driven test generator which supplies test signals into the R11 and R12 amplifiers while gating the system. In conjunction with the function generator, which produces signals from a radiation source, a total system check is possible.

(3) Pulse Processors—Provide scanner signal amplification. Gain and pedestal controls on front panel.

(4) Directional Data Control Unit-Transducer signals are processed to establish system control. Initiates gating, scanner shutter and heater control and provides timing feature.

(5) Reference Voltage Standard—Furnishes ripple-free bias for bolometer detector.

(6) Main Power Supply—Supplies 24 volts for scanner junction box and 200 volts for pulse processors.

(7) 12 Volt Supply—Provides 12 volts regulated and 12 volts unregulated for system control and bias circuits.

The design of the rail-mounted scanner and associated junction box is such that it can readily be retrofitted into all prior Servo hot box detector systems with circuit change. Comparison tests indicate accurate signal fidelity between the rail-mounted scanner connected into the Servo model 7707 and the rail-mounted 8808 checking the same journal.

Detector scans trains moving 5 to 150 mph

The hot box detective model 8808 is a trackside system for early detection of hot boxes of trains traveling at speeds ranging from 5 mph to 150 mph. The final readout of the thermal condition of journal housings is displayed as a recording on a chart or graph at the recorder which may be locally or remotely located. The recorder is also provided with alarm lamps which automatically register the existence of abnormally heated journals on either or both sides of the train when the high deflection indicator is utilized as a component part of the system. Additionally, the meter readout may be observed at the field site of the test panel on the data processing unit rack assembly (installed in signal house). Since the recorder is usually situated at a train control point, either the dispatcher or train controller has means at his command for alerting train personnel to stop trains suspected of having hotboxes.

The trackside installation consists of two enclosed rail mounted scanners on opposite sides of the track. The infrared optical system continuously scans the underside of the cars and journal housings as the trains pass the scanners. To avoid false alarms resulting from heat sources other than journal housings and to enable accurate location of the defective journals, only the heat pulses from the journals are recorded. These heat pulses, proportioned to the radiated energy from the journal boxes, are "gated" in when the optical system is scanning each passing journal box. This gating action is accomplished by two (A and B) precisely positioned transducers firmly clamped to the rail. The heat energy focused on the bolometer is converted into an electrical signal which is amplified and applied to the applicable rail 1 and rail 2 pulse processor.

The first wheel to pass the center of the C transducer (D transducer for reverse move), causes a pulse which is processed by the directional data control to turn the system on and provide direction sense. As each wheel passes the center of the A transducer (B transducer for reverse move), it generates a signal which is applied to the directional data control. The directional data control applies a "gate on" signal to the pulse processors and permits them to start storing the maximum heat signal from the scanners. The pulse processor also now generates a pedestal pulse, which is summed and stored with the heat signal from each scanner.

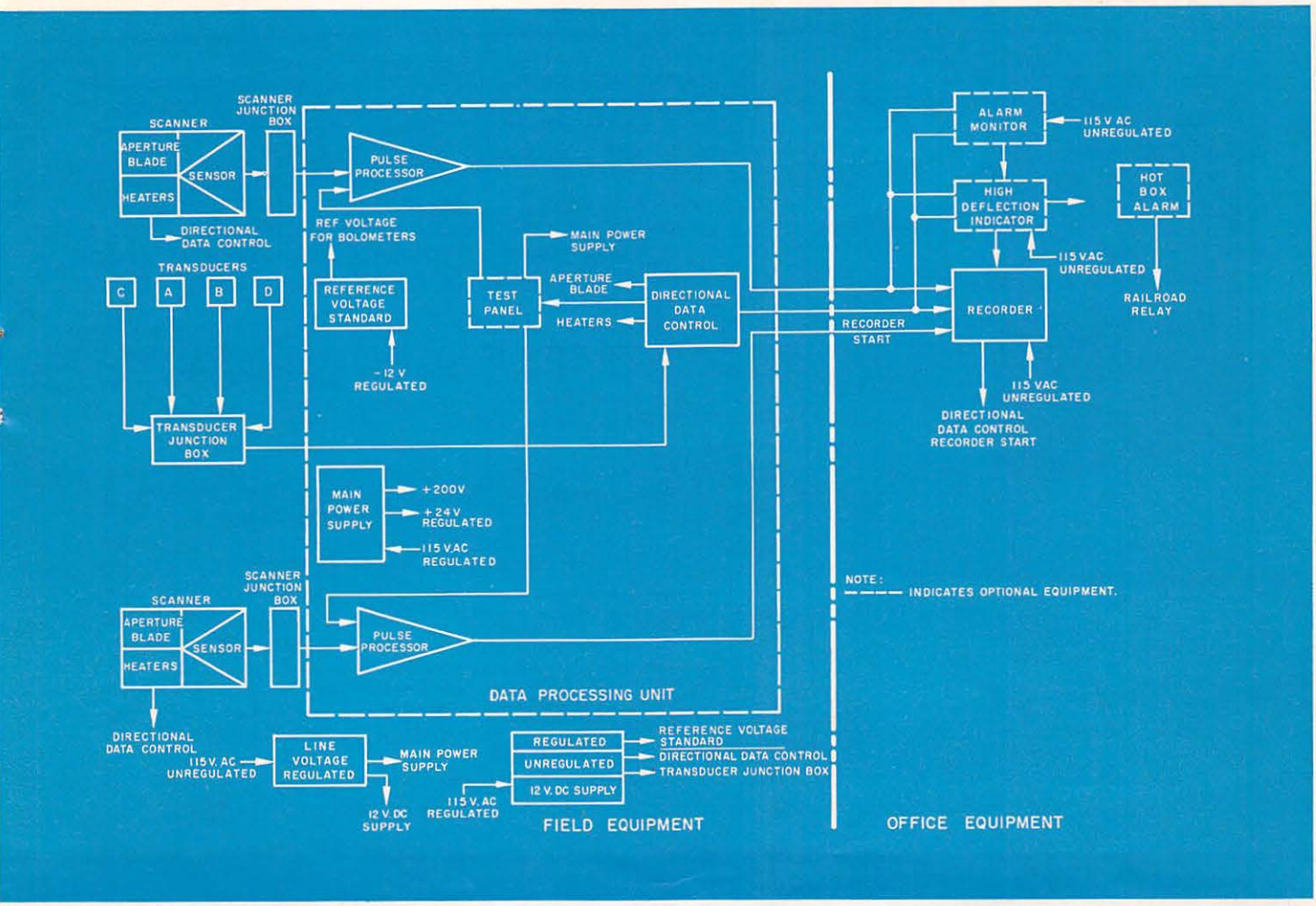
Note: The purpose of the pedestal pulse is to allow continued count of cold journals from cars which may have recently been added to the train. This precludes the loss of position of a hot box in relation to the front and rear axle of the train.

As each wheel crosses the center of the B transducer (A transducer for reverse move), it generates a pulse which is processed by the directional data control unit and resets the system to "gate off", causing the scanner heat signals applied to the pulse processors to be shunted to ground. In addition, at "gate off" time, the pulse processors transmit a synthetic pulse to the recorder, equal in amplitude to the sum of the stored pedestal and heat signals.

After the last wheel passes the center of the D transducer (C transducer for reverse move), the system "times out" and resets to await passage of the next train.

The recorder pen motors are driven by the pulse processor RL1 and RL2 outputs. The stylii imprint a mark on the paper for each journal box inspected. The amplitude of the mark indicates the relative temperatures of the journals scanned. By counting spaces between groups of four marks or pips, (representing two coupled sets of trucks) from the front or rear of the train, the observer is able to locate the car having the hot boxes as well as the side and position of the defective journal. In order to eliminate the possibility of miscounting, two cars on each side of the indicated defective car should also be checked by the train crew. As each succeeding wheel opens and closes the gate, the journal heat data is processed to the recorder until the last wheel of the train passes the B transducer.

Pulse processor outputs are also applied to the high deflection indicator via TB1 on rear of rack assembly. The



high defection indicator actuating levels are adjustable. When deflections which are above these preset levels occur, the high deflection indicator lights the rail 1 or rail 2 alarm lamps on the recorder front panel, or other alarm indications preferred by the railroad.

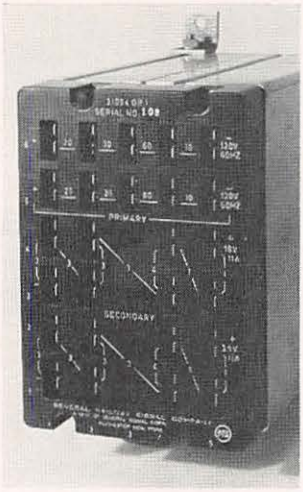
The rail 1 and rail 2 scanners are aligned so that the sensors scan the desirable cross-sectional area of the average journal box for each passing wheel. The speed of the train determines the time each wheel requires to proceed from the A to the B transducers. This period of time is the "gate on" period, which is the time of set to reset in the directional data control unit. Because of the ability of the bolometer to react rapidly to heat change, the speed of the journal passing the scanner does not appreciably affect system operation. Since a like cross-sectional area of the journal is scanned for each wheel passage between the A and B transducers, and bolometer reaction time is negligible, an effective method of limiting extraneous heat from undesired sources is accomplished by gating in the signal from the rail 1 scanner to the rail 1 pulse processor and from the rail 2 scanner to the rail 2 pulse processor.

Even though the sensors continually scan the bottom of the train along the journal route, the signal is processed and stored in the pulse processors only during the "gate on" period, and transmitted to the recorder only during the "gate off" period. The "gate off" period lasts from the time the front wheel passes the B transducer until the following wheel crosses the A transducer in a normal direction move. Since it is during this "gate off" period that much of the underside of the car with the undesired heat sources not applicable to journal heat might be present, gating off the signal prevents storing of this extraneous heat information in the pulse processor.

The 8808 system offers advance system control in such a manner that the system is effectively alerted to prepare for imminent train passage. Without advance system control, the first wheel of the train would pass the A or B transducer, dependent on train direction, before the scanner aperture opened and the recorder began to operate. Thus, the condition of the first journals of the train would not be indicated on the recorder chart.

By installing the C transducer uptrack from the A transducer and the directional data control in the ASC position, advance system control is effected. When the first wheel crosses the C transducer in the normal direction, the scanner aperture blade is moved aside, the heaters turned off, and the recorder started. By the time the first wheel crosses the A transducer, the sensor is ready to scan the journal and the recorder is ready to chart the relative heat pulses. For advance system control in reverse direction, the D transducer is located down-track from the B transducer. The same sequence of events occurs relative to D and B transducers in reverse direction as occurs relative to C and A transducers in normal direction. The relative position of transducers along the track in normal direction is, therefore, C., A, B and D.

Product News



Transformer has two primaries (101)

The universal transformer has two independent 120-volt primaries which can be connected either in parallel for a 120-volt input or in series for a 240-volt input. Each primary has 10-, 20-, 30-, and 60- volt taps. The two independent 18-volt secondaries are each capable of delivering 11 amperes at 1 to 18 volts in 1-volt steps. The secondaries are each capable of delivering 11 amperes at 1 to 18 volts in 1-volt steps. The secondaries can be connected in parallel to deliver 22 amp at 1 to 18 volts.

Two 0.250" Faston terminals, for quickly made, positive connections, are furnished for each tap. All terminals are protectively recessed in the impact-resistant Noryl resin terminal board. Numerals identifying the primary and secondary taps and interconnection lines are molded on the terminal board, as well as coordinate numbers for circuit reference.

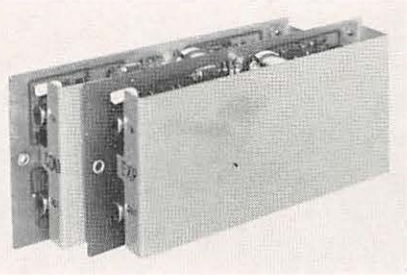
The mounting brackets are adjustable to permit weight-balanced support on the cross rails of a type B relay rack, leaving all terminals readily accessible on the wiring side of the rack. The brackets can also be positioned so the transformer can be mounted on a backboard or a shelf. *General Railway Signal Co.*

Electronics can be taught at home (102)

Independent study courses in electronics are available for home study, for on-the-job or classroom study and cover subjects from the introduction to electricity and electronics through to advanced techniques in instrumentation, communication electronics and leading to Federal Communications Commission second and first class radio telephone operator licensing.

In addition to independent study courses of electronics, independent study programs are available in four basic areas: (1) fundamental electronics; (2) electronic equipment and systems; (3) digital electronics; and (4) industrial instrumentation.

Testing and grading after each lesson is provided as well as technical consultation by a professional staff of instructors. Progress reports are issued and a certificate of completion after each course or program is available. *Bell & Howell Schools*



Compandors operate on voice circuits (103)

A compact, modular constructed system is designed to improve the clarity of voice transmissions over noisy circuits. Designated as type 70A, the compandor operates on standard levels used in telephone and multiplex systems.

The type 70A compandor provides up to 25 db of noise reduction, and exceeds the parameters recommended by CCITT. Electrical features include a compression ratio of 2:1, and a dynamic range of 60 db. *JDC Communications, Inc.*

Insulated joint comes in kit form (104)

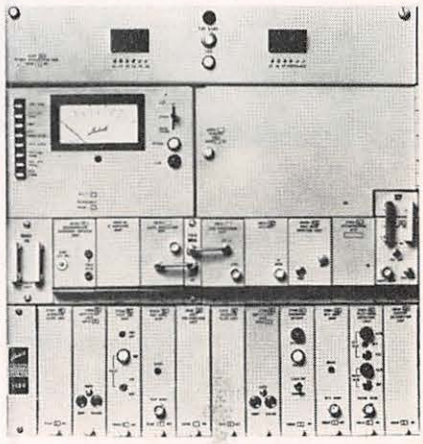
A heavy-duty insulated joint is available in kit form and is comprised of joint bars to which the insulation is permanently bonded, high-stregnth bolts, nuts and reactance washers, high-pressure laminated end posts, bolt-hole bushings, a cement kit and a procedure guide.

Each joint is assembled by railroad forces either in the shop or in the field. The shop can join rail sections of any convenient length for shipping and the resulting assembly is then field-welded into the strings in the track.

When fabricating the insulated joint, the manufacturer recommends the use of either a sandblasting unit or heavy grinder for removing the mill scale, a grease solvent, a torque wrench and, if available, a rail heater for accelerating the hardening of the cement bond. *Allegheny Drop Forge Co.*

Brochure gives data on VF cables (105)

A new brochure provides background information on the development of moisture resistant cables as well as data on weights, diameters, and standard lengths and complete electrical characteristics. In addition, a table of transmission characteristics for the cable from voice frequency through one megahertz is included for Qualpeth FPA type FC moisture resistant filled telephone cable. *General Cable Corp.*



Microwave operates in 1700-2300 MHz (106)

A new microwave system, designated the 78F2, operates in the 1700 to 2300 MHz frequency band, and has a maximum capacity of 600 message channels or a single video signal. Power output is 5 watts, and the system has a receiver noise figure of only 8 dB.

Hot-standby, frequency diversity and space diversity arrangements along with a wide selection of subsystem options suit the 78F2 to meet diverse communications applications. The 78F2 employs a single-step modulation scheme to produce the microwave output frequency. There are no

(Please turn to page 34)

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26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
51	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**
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NEWS BRIEFS

(Continued from page 10)

has pending before it appeals to the FCC's action in authorizing a Telpak rate increase early in 1970. This matter is also expected to be decided some time this summer.

Transitel to market KeyTran data system

Systems Engineering Laboratories Inc. and the Transitel Computer Support System division of the Sangamo Electric Co. have agreed that Transitel will market Systems' computer-based KeyTran system throughout the U.S. KeyTran, with its integral computer, accepts information simultaneously from up to 48 keyboard terminals on to a disc and, after verification and editing, writes the data on to a magnetic tape that is immediately ready for on-line processing.

According to the general manager of Transitel, Herbert J. Henderson: "Transitel's data entry product line of key-to-tape data stations, pooling systems, communications terminals and printers is now well-rounded with the complementing KeyTran system."

PC Gets OK from FRA to install CTC

Penn Central has received approval from Federal Railroad Administration hearing examiner, Robert R. Boyd, to install a traffic control system replacing a manual block signal system on single main track between Clearfield and Keating, Pa., about 52 miles.

SP supports FCC staff on special carriers

Southern Pacific Communications Co. has filed a statement with the Federal Communications Commission in its inquiry into proposed special service communications common carriers. SP's statement said in part that one of its main points was that "The staff analysis correctly perceived that claimed economies of scale by the carrier will be vitiated because of the necessity to standardize services—which has led in large part to the unsatisfied needs for specialized communications. One of the problems of a switched system such as that of AT&T is the large amount of central office equipment required.

(Please turn to page 35)

Common carriers, FCC battling key issues

By ROBERT C. KARVWATT
Director-Communications Services
Penn Central Transportation Co.

The question of should railroads expand their private communications systems or obtain service from common carriers is one which is particularly appropriate at this time. Railroads have, or course, been aware for decades of the need for extensive, reliable communications networks. Complete reliance upon their own networks had been commonplace throughout the nation until the demand for extensive expansion to handle the flow of data to automate operations and to provide improved coordination of activities forced a review of wire line plant costs, microwave and common carrier services.

Except for the northeast quadrant of the United States the railroads choice was private microwave systems. This selection of microwave systems was made for many reasons but the principal ones were the great distances to be traversed through sparsely populated areas and the lack of adequate common carrier facilities. Railroads in the northeast quadrant expanded their open wire and cable plant and finally when the economic limit was reached began to explore the potential application of private microwave systems.

The one, outstanding, single development, which occurred during the 1960's was the introduction of what are known as the TELPAK tariff offerings by the common carriers. For the first time the telephone companies gave recognition to the possibility of real competition from privately owned microwave systems. As originally offered and structured the TELPAK tariffs provided an economical means to meet the bulk communications requirements of a broad spectrum of users. Briefly, the charges were based on a flat rate per mile to compete with microwave bandwidth and channel terminal charges corresponding to the subdivision of the baseband into voice and data channels. Not only were the costs competitive but there were other built-in advantages such as the ability to cancel on 30 days notice, rerouting of sections and termination at the customers site.

The TELPAK tariffs have been subject to litigation from their inception. TELPAK classifications A (12 channels) and B (24 channels) were eliminated in August, 1967 after many appeals of an FCC decision of December, 1964. In September, 1968 and again in February, 1970 rates were increased and the telegraph/telephone equivalency was reduced from 12/1 to 2/1. The FCC's decision with respect to the TELPAK tariffs have been appealed to the courts and a decision has not as yet been rendered, meantime the rate increase is subject to an accounting order and if found to be illegal refunds will be made.

Adding to the foregoing confusion with regard to the TELPAK rate structure are several other pertinent proceedings. The FCC has initiated an investigation into the level of all private line rates. This investigation is still in progress. The sharing provisions of the TELPAK tariffs have been attacked and held to be discriminatory by the FCC and AT&T was ordered to eliminate the discrimination by broadening sharing to all users. Again this decision has been appealed to the courts and a decision is awaited. As if these preceedings were not enough there are now attempts to tie the private line rate investigations into the recently opened rate hearings on AT&T's requests for increases in message toll rates. It is obvious that in this climate it is difficult to recommend communications plans which depend upon TELPAK as the base. The continued existence at competitive rates of the one viable alternative to private systems is seriously open to question.

Turning now to the question of costs. While generalization is dangerous there can be little argument that the rates charged in the original TELPAK offering were competive with private microwave systems. The current levels require a re-examination of the question. The variation in costs of microwave systems of varying baseband capacities of 120 to 600 channels is relatively slight. The difference is primarily in the area of RF equipment and antenna costs. When these costs are related to annual costs over the life of the system the difference becomes negligible. In fact one would probably install the system with the greater capacity as an investment for the future and to provide an opportunity to reduce costs through sharing. Technological advances over the past decade have produced equipment with greater reliability and a wide range of choice with regard to frequency and bandwidth. Systems can be tailored to meet almost any requirement.

Assuming that the basic transmission system is competitive let us examine other areas of consideration. To have a truly useful system it is necessary to interconnect with common carrier facilities and the message toll network.

Railroads have historically enjoyed certain interconnection rights. However, these were restricted and generally required common carrier furnished PBX's and operator control. The Carterphone decision opened the door to generally unrestricted interconnection of company owned circuits and equipment to the toll network. In addition, revisions to AT&T tariffs provide for the furnishing of entrance facilities. These entrance facilities can be used to interconnect microwave terminals to city offices. The new provisions are in addition to the historical provisions. To provide for network protection against harmful signal levels and protection of personnel certain protective devices are required.

A National Academy of Sciences panel made a study of the need for this protection and concluded that harm to the message toll network could result from indiscriminate interconnection, but the protection could be obtained through properly certified and installed equipment or through the use of telephone company provided protective couplers and network control signaling units. The procedures associated with the proposed certification program have not as yet been resolved and the entire subject is being discussed and studied by a number of organizations. It appears that a reasonable program can be arrived at in due time.

The easing of interconnection restrictions has an important bearing on private system design. Technological advances in the area of electronic switching equipment, both telephone and data, in data modems and terminal equipment offer the system designer a choice of equipment and features not generally available from the telephone companies. This should not be interpreted as such facilities are not available, but that the rate of installation and the general availability is low. Innovation is a slow process in a generalized network.

The need to respond promptly to changing operational requirements; to restore out of service facilities, and to establish installation priorities; in other words, control, has often been cited as one of the primary reasons for the in-

stallation of a private system. The service provided by the telephone companies had, until the last few years, been acceptable. The information system explosion in recent times has taxed the ability of the telephone companies, particularly in the larger metropolitan areas, to keep up with demand. The introduction of new devices and the demand, particularly from the computer user, for more reliable and higher grade service has increased the level of competence required of maintenance personnel. As a result despite the extensive effort on the part of many telephone companies to overcome the problems of installation scheduling and maintenance, the grade of service has suffered. As the use of customer provided equipment increases, the demand for skilled technicians will increase and the availability of trained personnel will be affected. In the close environment of a private communications system it should be possible to provide a higher level of training and develop a greater sense of dedication to the work at hand. Work priorities can be established without the need to relate these priorities to those of many demanding customers.

Railroad communications systems cross boundaries of many states and the common carrier system to supply their needs requires the interconnection of facilities furnished by many telephone companies. Each of these companies has its own rate structure and service offerings. The charges for these services vary considerably from one company to another. New tariff filings are being made almost daily. The number of rate change filings within the past year has been unprecidented. It is impossible for a single customer with our diverse interests to keep up with these filings. The result is a significant increase in costs. Test tariffs are being filed by various telephone companies scattered about the country. Some of these filings are designed to generate increased revenue by charging for the amount of information transmitted in addition to the normal connection charges. The application of such concepts could materially affect our costs for data transmission. The recent filings in Illinois are an example.

In 1968 the FCC approved the application of MCI for the construction of a specialized common carrier network to be installed between Chicago and St. Louis. The approval of this system unleashed a flood of applicants for permits to install systems which would interconnect most major cities throughout the country. These applicants propose systems which they say will overcome deficiencies in the toll network for data transmissions and provide customized services. The initial costs of these services are projected at lower levels than normal IXC rates. Although the first MCI system was approved over two years ago, it has yet to be placed in service. Implementation has been delayed by appeals to the FCC, application changes and appeals to the courts. Effective operation of such systems still appears to be several years in the future. Whether these systems will be a viable alternative for railroads cannot be determined at this time.

Another recent development of interest is the granting by the FCC of a license to the Preston Trucking Co. to construct a microwave system between Philadelphia, Pa. and Buffalo, N.Y. to be shared by the trucking industry. The system would be owned, installed and maintained and leased to Preston by TMC of Syracuse, N.Y. Costs would be shared by the participants. Immediately after the FCC approved the license and Preston's filing of the list of prospective sharers, AT&T among others protested to the FCC on the grounds that the operation was really a specialized common carrier system and not a shared microwave system in accord with existing FCC rules. The FCC has now suspended the sharing authorization pending further investigation. It will be interesting to observe developments in this case as they could provide a base for interpretation of the sharing rules.

AT&T has new channel offering

In an attempt to meet the need of users with point-to-point relatively narrow bandwidth requirements AT&T introduced its series 11000 channel offering. As this tariff is experimental, limited in service points, and requires a contract for a fixed period of time, it has not proved to be an attractive item. TELPAK rates are still competitive with the series 11000 and large users of bulk communications would only turn to this new offering as a last resort. The concept of bulk rate offerings has received acceptance from the FCC provided there is no discrimination among users. Various informal proposals for tariffs to substitute for TELPAK have been put forth and are under discussion but as of this time, no formal filings have been made. It is quite likely that if material changes to the TELPAK tariffs are required, AT&T will file a new tariff, conforming to FCC guidelines. This will be necessary to avoid the large loss of revenue which would occur through the installation of privately owned systems by large users.

Most industrial users do not wish to enter the communications business provided that service can be obtained from the common carriers at reasonable rates; that the service supplied has high reliability; that facilities of the proper type are available; and no large investment in construction costs is required.

Common carrier service does have the advantage of quantity and diversity, competitive rates, does not require capital investment, it is flexible and can be changed at reasonable notice to meet changing operational requirement and nationwide maintenance is available from one source.

Presently offered common carrier service does suffer from several disadvantages. The user has little or no control over rates, installation schedules. restoration priorities, or in the details of the service provided and variation in rates and offerings from one carrier to another. Construction charges for special facilities are high. Innovation is slow and desirable features are not available in all areas.

The principal advantages of a company-owned communications plant are control of costs and quality of service, freedom from the influence of regulatory bodies and ability to take advantage of the most recent technogical advances. Among the disadvantages are the large capital investment required, cost or obsolescence due to need to relocate system or change in corporate structure and need for qualified personnel.

Unfortunately, no solutions have been offered to this problem. No longer is it a simple case of arriving at an economic decision. The regulatory aspects cloud every issue. The current posture of the common carrier will be largely effected by the introduction of competition in this previously sacrosanct area. The full impact of the specialized common carrier will not be apparent for some years.

The question uppermost in the mind of the communications system planner is how long can we afford to wait and what price will we pay for indecision. As communications demands increase, so does the pressure. Experience with railroad shared TELPAK has shown the major backbone routes are relatively static. Microwave system costs are competitive. Broadening of interconnection adds the required flexibility. Communications systems experience exists within the industry. On balance, in the present climate, the privately-owned communications appears to have the edge.

ADVERTISING INDEX

Cable Communications Inc., *(Culver Advertising, Inc.)* 6
Computer Identics Corp. *(Sacks Advertising)* 33

Edison Battery Division, McGraw-Edison Co. 9

General Railway Signal Co. *(Rumrill-Hoyt, Inc.)* 29
Gould Inc. *(Barickman & Selders Advertising Inc.)* .. 4
GTE Information Systems, Inc. *(Doyle, Dane Bernbach, Inc.)* .....IBC
GTE Lenkurt, Inc. *(Hoefer, Dieterich & Brown, Inc.)* 8

The Kerite Co. *(O. S. Tyson & Co.)* 20-21
Kershaw Mfg. Co. *(Douglas Harrison Advertising)* ... 11

Nife, Inc. *(Stewart H. Ross Advertising)* 7

Power Systems & Controls Inc. *(Washington & Lee Advertising)* 35

Railroad Accessories Corp. *(Faber Advertising, Inc.)* .IFC
Railway Signal & Communications Suppliers Association 37

Servo Corp. of America *(Industrial Marketing)* 12
Stromberg-Carlson Corp. *(Rumrill-Hoyt, Inc.)* 3

Western-Cullen Division, Federal Sign & Signal Corp. *(Merrill, McEnroe, Fox & Associates)* ....33, BC
J. H. Williams & Co. *(Lloyd Mansfield Co., Inc.)* 30

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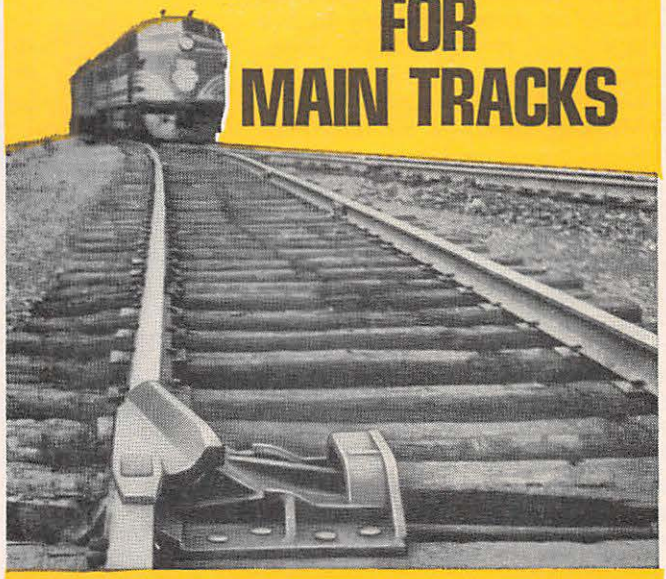

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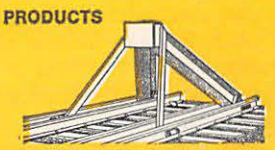

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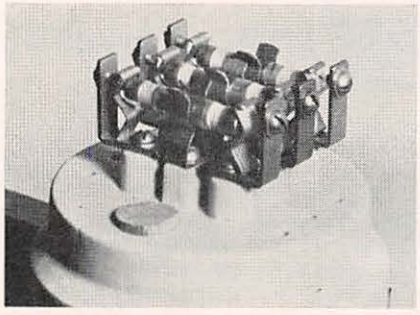
PRODUCT NEWS

(Continued from page 28)

multipliers of any kind in the system to degrade performance.

Total solid-state design allows the 78F2 to be operated directly from a −24 volt DC or −48 volt DC power source. Power consumption is 60 watts per single-channel terminal.

Metering functions on the transceiver allow power output, deviation, frequency and receive signal level to be monitored by pushbutton selection. Built-in alarm circuits provide a constant check of equipment performance. In hot standby applications, the transmitter employs solid-state switching circuitry. Transfer speed is less than 1 microsecond with more than 85 dB of isolation and less than 1 dB of additional insertion loss. Power, off-frequency and pilot alarm circuits have minimum sensing time to ensure positive, reliable transmitter switchover. *GTE-Lenkurt Inc.*



Arrester tubes take 72,000 volts (107)

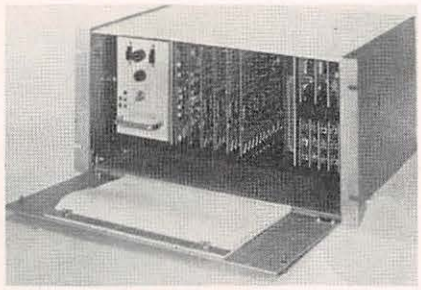
Gas-filled lightning arrester tubes, type 16, have been able to withstand 72,000 volt surges. The tubes contain three elements hermetically sealed in a ceramic and metal cartridge, bonded together by high-temperature brazing.

The arrangement of the electrodes ensures near-simultaneous operation when excess voltages appear on any two electrodes. As a result, circuit balance is achieved. The tubes operate in one microsecond; discharge 20,000 amp peak, 20 amp for one second repeatedly, 150 ma for three hours.

Three ranges of striking voltages are available 150-350 type 16A; 350-500 type 16B; and 600-900 volts type 16C. *Western Cullen Div. Federal Sign & Signal Corp.*

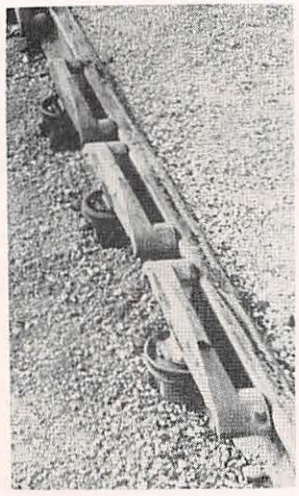
Test units designed for radio (108)

A new catalog of test equipment custom designed for two-way radio includes details on the new service monitor, oscilloscopes, frequency meters, counters, signal generators, AC voltmeters, DC multimeters, audio oscillators, RF wattmeters and power supplies. *Motorola Communications & Electronics, Inc.*



Data unit stores com codes (109)

Model DSU data storage unit is for storage of ASCII, Baudot and other codes in temporary electronic storage. The DSU is capable of storing from 4,000 to 40,000 data words (characters), receiving and transmitting them at speeds of up to 300 baud, or with an automatic buffer, up to 9600 baud. It operates from 120 or 240 volts, 50 to 60 Hz. *Pulse Communications Inc.*



Retarder has braking continuously (110)

Hydrabrake units provide continuous, automatic, unattended control of single cars or long cuts, loaded or empty. The braking units do not grip the wheel. Instead they present, in the path of the flange, a pair of pads on a pivoting arm. As the flange contacts the leading pad, the energy required to depress it retards the speed of the car. Meanwhile, the trailing pad automatically pivots into position to further control the speed as the pad is depressed. The same action resets the leading pad for the following wheel.

Hydabrake works on the hydraulic principle. An oscillating piston forces oil through a small orifice to provide the restrictive resistance that controls the car speed. The greater the speed, the heavier the retarding action. The piston and oil reservoirs are housed in the base on which the pivot arm is mounted, comprising a self-contained unit for bolting to the running rails. *Whiting Corp.*

Frequency voltmeter displays digits (111)

The all new frequency selective voltmeter, model 4200 has a six digit frequency display. A counter mode selector switch allows the user to monitor a tunable preset frequency (Mode 1), or restore the incoming signal to its absolute frequency (Mode II). Frequency ranges from 20 Hz to 200 KHz. The distortion products are below −70db.

It is powered by an internal Nicad battery. Also, it operates off 110-volts AC. The 4200 size: 9" high by 13¼" wide and 8½" deep and weighs 20 lb. *Harmon Electronics Inc.*

I/O unit has numeric input (112)

A numeric input device can be used with buffered data communications terminals to provide off-line entry and recording of numeric data on magnetic tape. Terminals can be ordered equipped with the new numeric input, or the device is available as an "add-on", attaching to any Novar terminal through the built-in socket on the back side.

Called the Novar 5-02, the device is equipped with an adding machine keyboard layout with numbers 0 through 9, and with additional keys for decimal point, plus sign.

The operator may print out the information being entered on magnetic tape by merely pressing the Print key on the terminal. It is also possible to prepare pre-printed forms, such as invoices at speeds much greater than that possible with ordinary typewriters and billing machines. *Novar Corp.*

NEWS BRIEFS

(Continued from page 30)

"Since the AT&T facilities were originally engineered and expanded for voice communications, the attempt to use the system for specialized services increases both the engineering and the cost of central office equipment enormously. Conversely, the non-switched service proposed by Southern Pacific as a specialized common carrier will be designed under substantially improved technology, making use of new communications requirements and capabilities."

CPU inquiry decision temporarily held

FCC's computer decision is temporarily "up in the air" as a result of opponents filing for reconsideration. The Commission had set May 18 for responses to opposition to petition. Some opponents, such as General Telephone and United Telephone Systems, have filed notices of appeal with the U.S. Court of Appeals.

According to *Telecommunications Reports,* the Commission, in turning down pleas for a stay longer than May 18, took the position that the requisite showings of irreparable injury, and substantial likelihood of prevailing in the courts, have not been made. It did not dwell on the subject of possible outcome in the courts, but emphasized its view that irreparable injury had not been shown.

In that regard, the FCC noted that the principal allegation of injury stems from the requirement in the 4-3 ruling that common carriers may not obtain data processing services from their own affiliates if the latter also serve other customers. It said that while the computer ruling would have become effective April 30 without the 10-day stay to get to court, the objected-to provision would not become effective for six months thereafter.

British Railways orders signal equipment

British Railways Board—Scottish region has awarded two major contracts to AEI-General Signal Ltd. for resignaling of the West coast main line and for Cadder-Falkirk line, which equipment is necessary in connection with future railway electrification. The award to AEI-General Signal Ltd., of these major contracts totalling £6 million (U.S. $14½ million approximately) are the first two contracts to be awarded under a new allocated contract agreement of British Railways for their five-year re-signaling program.

Missouri Pacific will install microwave

Missouri Pacific will install two microwave systems during the coming year to provide additional circuits for its transportation control system. One microwave system will be installed between Pleasant Hill and Nevada, Mo., 70 miles, and a second will be constructed between Osawatomie and Coffeyville, Kan., 123 miles.

Also, MP plans to purchase communications equipment for its terminal car control and customer service centers at 13 locations.

C&EI plans signal changes this year

Chicago & Eastern Illinois is planning to install 113 miles of centralized traffic control between Findlay Junction and Benton Junction, Ill. Other signal projects for this year include

(Please turn to page 37)

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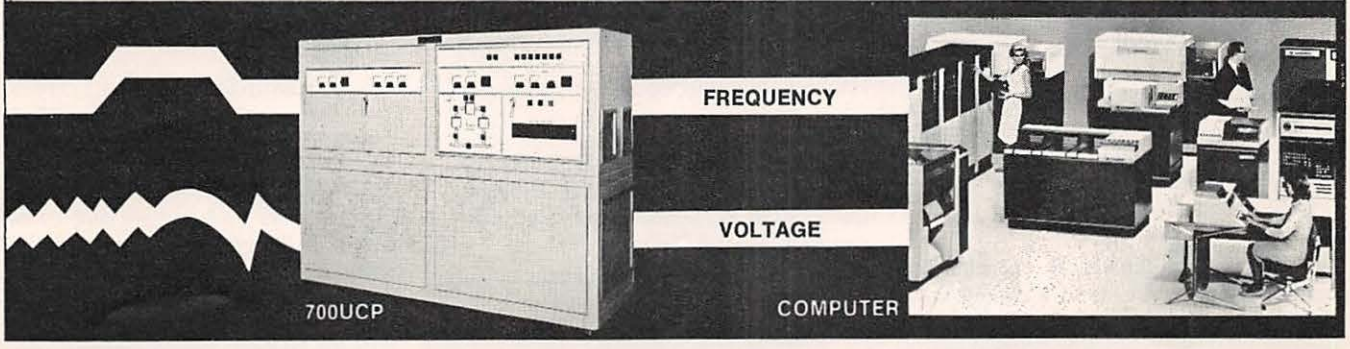

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People

ASSOCIATION OF AMERICAN RAILROADS: **Harry Peterson,** vice chairman of the car service division, appointed director of information processing division.

BURLINGTON NORTHERN: W. R. **Stockton** appointed director industrial engineering at St. Paul, Minn.

CHESAPEAKE & OHIO: **John B. Hardgrove,** signal inspector at Huntington, W. Va., appointed supervisor of signals at Ashland, Ky.

CHESAPEAKE & OHIO/BALTIMORE & OHIO: **J. R. Winter** appointed senior circuit engineer signals, and **G. O. Johnson** appointed circuit engineer signals at Huntington, West Va. **G. L. Fuller** appointed manager transportation computer operations at Baltimore. **John M. DeArment,** signal application engineer, appointed junior circuit engineer signals. **Milton E. LaCoss,** circuit engineer, appointed senior circuit engineer signals. **Donnie R. Devore,** signal maintainer, appointed circuit engineer signals. **Steve A. Courts** appointed communications inspector. All the above men are headquartered at Huntington, W. Va.

LOUISVILLE & NASHVILLE: **Raymond H. Billingslea** appointed general foreman communications inside plant.

James O. Higgins, signal repair foreman, Louisville, appointed assistant signal supervisor, Evansville Division. **Donald R. Myrick** succeeds Higgins as signal repair foreman. **Charles D. Leddon,** director industrial engineering, appointed assistant vice president industrial engineering at Louisville.

Ralph L. Blackwell appointed supervisor of signals Louisville, Ky.

SEABOARD COAST LINE: **J. E. Barker** appointed signal construction engineer at Denmark, S.C. **E. L. Johnson** appointed signal engineer Jacksonville, Fla. **N. H. Upchurch** appointed assistant supervisor signal construction. **J. W. Crawley** appointed office engineer-communications and signals, also at Jacksonville.

SOUTHERN: **Donald H. Holliday,** manager procedures and forms control, appointed director information services, management information services, Atlanta. **Samuel A. Means** appointed assistant district signal and electrical engineer at Greensboro, N.C. **Rayford C. Pace,** district signal and electrical engineer, Birmingham, Ala., appointed signal and electrical superintendent, Atlanta. **Richard L. Sauder,** senior operations research analyst, appointed director operations research, management information services, Atlanta. **Carey H. Waller,** signal and electrical supervisor, Macon, Ga., appointed assistant district signal and electrical engineer, Somerset, Ky. **Arthur L. White, Jr.,** assistant district signal and electrical engineer, Somerset, Ky., appointed district signal and electrical engineer, Birmingham, Ala.

William J. Day
Western Pacific

Herman G. McGrath
Marquardt Ind. Prod.

WESTERN PACIFIC: **William J. Day,** formerly marketing manager, Martin Marietta Co., appointed director of management services at San Francisco.

Suppliers

ACI SYSTEMS CORP.: **Christopher C. Reynolds** appointed manager-customer service engineering, with headquarters in Chicago.

GENERAL RAILWAY SIGNAL CO.: **S. M. Latone,** district manager, Boston, appointed manager application engineering with headquarters in Rochester, N.Y.

MARQUARDT INDUSTRIAL PRODUCTS CO.: **Herman G. McGrath,** former sales engineer, Signal & Communications Div., WABCO, appointed regional communications manager at Chicago.

OKONITE CO.: **Robert H. Finke** appointed sales representative, Birmingham. **Hugh W. Gaston** appointed sales representative, Charlotte, N.C.

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Richard A. Guba, manager industrial marketing, appointed manager New York district for the wire and cable division.

SANGAMO ELECTRIC CO.: **John F. Rilling,** marketing manager of communication systems, appointed assistant vice president and general manager communication systems.

SYCOR, INC.: **Paul C. LaVoie,** eastern regional manager, appointed national sales manager, Ann Arbor, Mich. **David J. McCue,** sales representative, New York, appointed district sales manager there. **Clem J. Dee** appointed national field service manager, Ann Arbor. **Robert W. Roth** appointed district sales manager with offices at 1815 North Fort Myer Drive, Arlington, Va. 22209. **Irvin A. Murray** appointed district sales manager with office at 615 Iron City Drive, Pittsburgh, Pa. 15205. **Stephen K. Paul** appointed district sales manager located at 907 North Elm Street, Hinsdale, Ill. 60521.

WABCO, SIGNAL & COMMUNICATIONS DIV.: **E. C. Dwyer,** application and design engineer, appointed senior consultant. **John W. Hansen,** manager marketing communications appointed manager marketing services. **Robert M. Karow,** manager market planning and development appointed manager of terminal markets. **C. E. Stipancic,** manager railway markets appointed manager of train control and signaling markets.

WESTERN-CULLEN DIV., Federal Sign & Signal Corp.: **Jack Clawson** appointed sales representative for the states of Arkansas, Louisiana, Mississippi and Texas with headquarters at Monroe, La., for the Clawson Railway Supply Co., sales agent for W-C products.

Obituaries

D. E. ERICKSEN, assistant director, operations analysis, Burlington Northern, died May 24 at St. Paul.

ARTHUR W. FISHER, retired section engineer and engineering consultant for the former Union Switch & Signal Co. died May 8 at DeLand, Fla.

PARK HYDE, 88, formerly associated with Thomas A. Edison, died last month. Hyde, in the 1930's, promoted the "two-train" indicator used with wig-wag signals.

NEWS BRIEFS

(*Continued from page 35*)

replacing of 3 attended interlockings with automatic interlockings. Also, another attended interlocking will be remotely controlled from another location.

Radoc announces ability in data communications

Radoc, Inc., a newly formed corporation located at 6060 Duke Street, Alexandria, Va. 22304, announces capability in data communications for consulting, market research and systems engineering based upon previous extensive service to the railroad communications community. Raymond B. Gelinas is president.

PBX standards group organizes for work

The Federal Communications Commission's advisory committee on private branch exchange switchboard interconnection standards met May 17 to decide on its subcommittee structure, organize into subcommittees, and fix target dates for the completion of assignments.

Preston Trucking told not to share by FCC

Federal Communications Commission has advised Preston Trucking Co. not to permit shared use of its private microwave system, previously authorized between Buffalo, N.Y. and Philadelphia, Pa. FCC said that several organizations had requested reconsideration of the initial authorization.

Santa Fe has signal training program

D. W. Inskeep, signal maintainer, La Junta, Colo., is the first Santa Fe employe to complete a new student signalman training program. The program was initiated by an agreement between Santa Fe and the Brotherhood of Railroad Signalmen in 1968.

The training program which became effective March 1, 1969, requires that all new signal employes pass a qualifying examination indicating they are capable of completing a correspondence course qualifying them as signalmen. The course is in four parts, three of which are from the Cleveland Institute of Electronics and covers basic electronics, algebra, trigonometry, alternating current circuits, and basic electricity. The fourth part was prepared by the Santa Fe and covers many aspects of railroading as applied to railroad signaling.

Designed as a two-year course, the employee is allowed six months to complete each section. Inskeep completed the course in less than one year, enrolling in Part 1 on January 7, 1970, and completing Part 4 on December 4, 1970. He recently received a certificate recognizing his completion of the student signalmen training course. He is currently filling a temporary vacancy as special TCS maintainer at LaJunta.

PC to spend $1,778,000 for signal systems

Penn Central is planning to upgrade highway grade crossing protection at Dayton, Ohio. It will install centralized traffic control between Johnstown and Kiski Junction, Pa. Additional signal projects during the coming year include providing remote control of three interlockings at Newark, N.J., Brownsville and Philadelphia, Pa. A traffic control system will be installed on the Detroit branch and fault detection equipment will be installed in the vicinity of Selkirk, N.Y.

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Editor's Corner

How to obtain quality control in EDP

Quality control is usually thought of in connection with manufactured products. Lately, railroads have been applying quality control in the form of performance standards for terminal operations and customer service. A key area where quality control can prevent monetary losses as well as improve the product is in data processing.

"Computers don't make mistakes," but people do, and people prepare input data for computers, program the computers and operate computer systems. "Therefore traditional control techniques still can be important and should be evaluated in terms of their usefulness to EDP systems. In addition, new control concepts must be devised to use the powerful capabilities of the computer. Although top management has the primary task of formulating a basic control policy, *all* employees connected with an EDP system have a responsibility to ensure that data processing is adequately controlled," says Joseph J. Wasserman, president, Computer Audit Systems, Inc.

EXECUTIVE HEADS EDP EFFORTS

"One slowly developing trend that fosters this approach is the strategic placement of a qualified top-level executive whose primary responsibility is to direct the corporate computer efforts. With this technical know-how available on the executive level, the company has taken a positive step toward establishing an up-to-date control philosophy. The company can then establish meaningful procedures to protect computer programs and data against error, malice, fraud, disaster or system breakdowns," Wasserman says.

To determine how well controlled the computer system is, the following questions should be answered. A *yes* answer to all or most questions indicates a well-controlled system. *No* answers indicate potential gaps in quality control in data processing.

—Is there an overall control philosophy?
—Are there production and machine controls?
—Are inputs, outputs and errors controlled?
—Is there a quality control unit?
—Are program changes controlled?
—Are systems adequately tested?
—Are adequate controls provided for conversion?
—Are there proper separation of duties?
—Is there proper security in the computer centers?
—Are there disaster procedures for files, programs, and hardware?
—Is there insurance against total disaster?
—Is the data processing system auditable?

Audit trails are vital in any system, and especially so in data processing. The $1 million check which should have been $100 is but one of the more obvious errors generated by computers. The real problem is to track down the many small errors that cumulatively cost many dollars. The cost may not be so obvious as incorrect payments or bills, but in excessive computer time in making corrections, lengthy programs requiring extra computer processing, etc.

It should be obvious that audit requirements be made known to the system people as early as possible so that audit trails can be built into the data processing system. Also, says Wasserman, "the EDP auditor should attempt to make optimum use of computer technology as an audit tool. He should attempt to have audit techniques and routines built into the computer system, where it is feasible and economical to do so. In this manner, much of the auditing work can be performed as a byproduct of the regular operation at little or no extra cost."

FLEXIBILITY AND CONTROLS

The computer or data processing system should be flexible enough to provide for changes with a minimum of effort and programming. Controls must also be flexible to meet these changes. However, each control function should be interlocked with other control functions so that a failure of one control is corrected by others. Also, controls must take into account human actions and failures.

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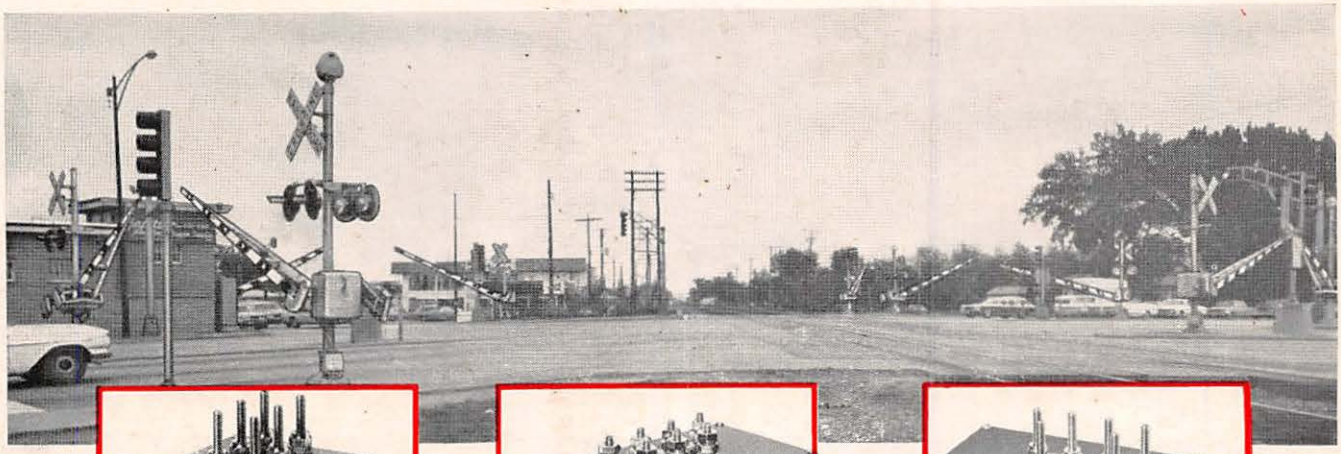

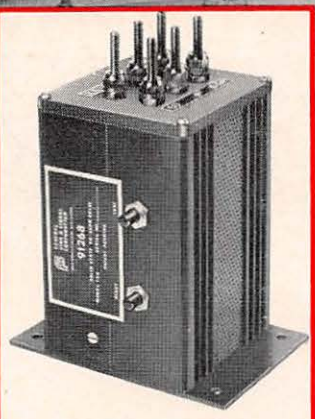

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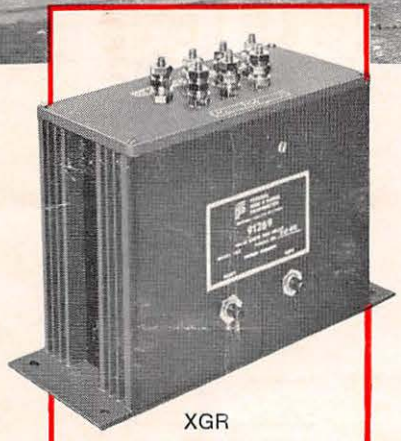

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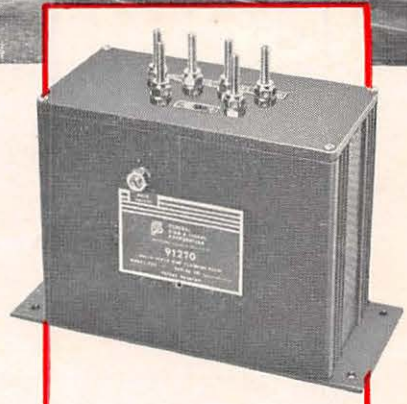

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